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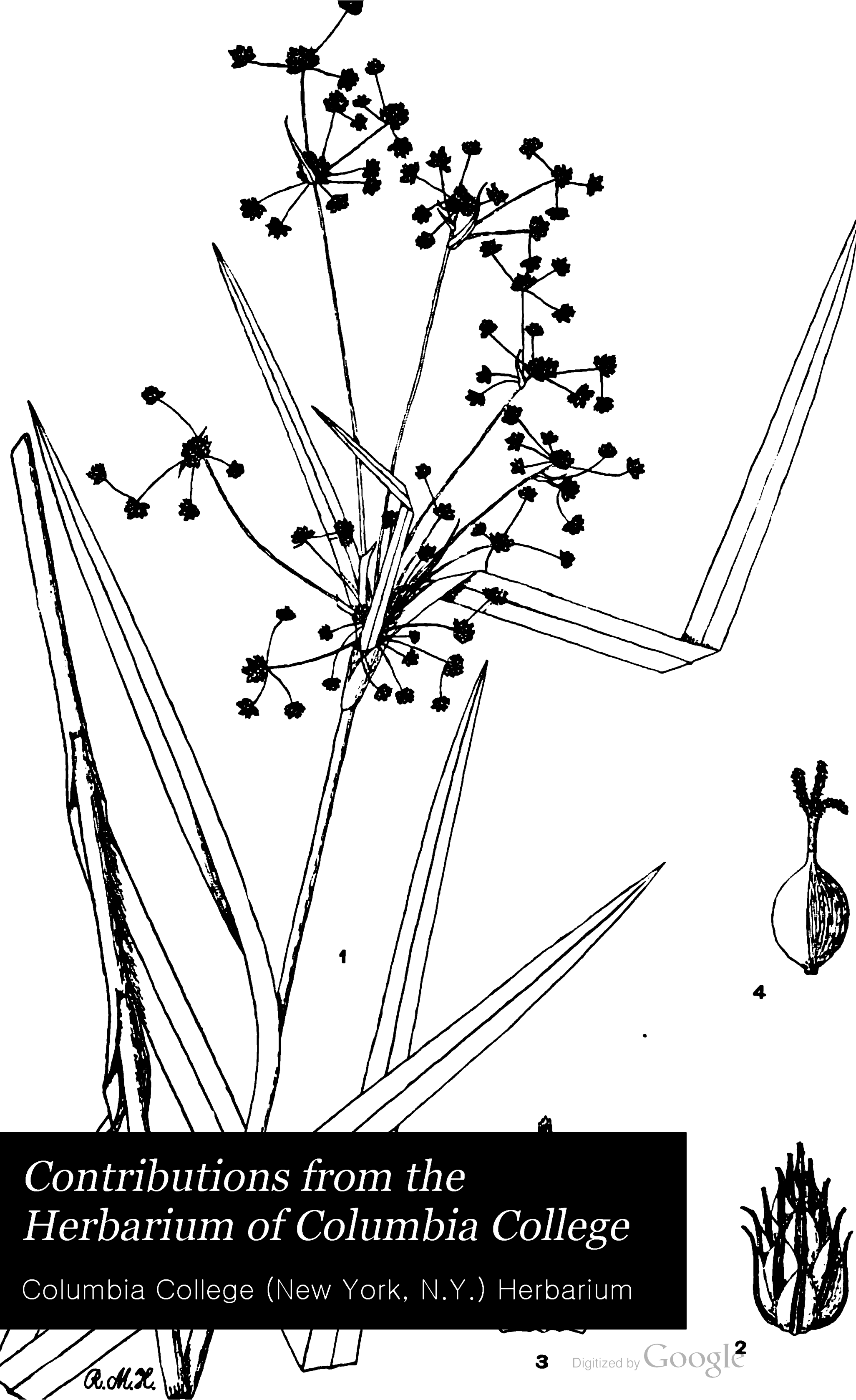

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CONTRIBUTIONS

FROM THE

DEPARTMENT OF BOTANY

OF

COLUMBIA UNIVERSITY

VOL. 7

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 151

Revision of the Genus Triplasis

BY GEORGE V. NASH

[Reprinted from the BULLETIN OF THE TORREY BOTANICAL CLUB, 25: 561–565, 7 N. 1898.]

Revision of the Genus Triplasis.

By Geo. V. Nash.

This group of plants has been frequently considered a part of the genus *Triodia*, founded by Robert Brown on a number of Australian grasses which bear little more than a superficial resemblance to our plants. Hackel * so considered the group, but Bentham & Hooker † adopted the views of Beauvois and gave to it the dignity of generic rank. It has seemed to us for some time that the genus *Triodia* embraced too many forms and that it would be much more satisfactory to divide it into several smaller groups. *Triplasis* approaches most closely to those plants that have been referred to *Triodia* under the specific names of *avenacea*, *pulchella*, *Nealleyi*, etc. The flowering scales are deeply 2-lobed as they are in those plants, but the internodes of the rachilla of the spikelet in *Triplasis* are much elongated and the callus is very long, sometimes two thirds as long as the internodes, and attached to the rachilla by a long oblique angle. The callus being densely pilose on the free side gives the rachilla internodes the appearance of being pilose on one side for a part of their length. This long and manifest callus with its very evident oblique attachment is a character not known to us to occur in any other of the many forms that have been referred from time to time to *Triodia*. The conclusions of Beauvois certainly seem tenable and better serve the end of systematic botany than does

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* Engl. & Prantl, Nat. Pflanzenfam. 2^2: 68. 1887.

† Gen. Plant. 3^2: 1176. 1883.

[Issued 7 November.]

the alternative, the merging of the group with a genus that has, under present conceptions, already passed far beyond the bounds of reason or expediency by having incorporated in it a number of well-marked groups that might much better be treated as genera.

The genus *Triplasis* is not a large one, nor is it extensively distributed, its three species being confined to North America east of the Rocky Mountains, and mainly to the vicinity of the coast, but one species, *T. purpurea*, occurs in the interior. The other two are found only in the coastal region south of Virginia, one of them, *T. intermedia*, being known at present only from Florida.

TRIPLASIS Beauv. Agrost. 81, *pl. 16. f. 10.* 1812.
[DIPLOCEA Raf. Am. Journn. Sci. **1**: 252. 1818.]
[MERISACHNE Steud. Syn. Pl. Gram. 117. 1855.]

Tufted grasses with simple or sparingly branched culms narrow flat leaves which are usually involute when dry, and terminal and lateral few-branched panicles, the latter concealed in the sheaths. Spikelets few, on short pedicels, 2–4-flowered, the flowers perfect or the upper one staminate; rachilla glabrous, the internodes above the first flowering scale much elongated. Scales 4–6, usually purple or purplish: outer 2 empty, keeled, 1-nerved, acute or acuminate: flowering scales deeply 2-lobed at the apex, the lobes truncate to acuminate and pointed, 3-nerved, the nerves densely pilose with ascending hairs, the awn arising between the lobes, shorter than or exceeding them, pilose for part of its length; callus manifest, densely pilose, wedge-shaped or subulate, obliquely attached to the rachilla, its hairs making the internodes appear as if pilose on one side for part of their length: palet shorter than the scale, compressed, 2-nerved, the nerves pilose, the hairs on the lower part short, those on the upper part abruptly much longer and forming a conspicuous tuft. Stamens 3. Styles short, distinct: stigmas plumose. Grain cylindric, free, loosely enclosed in the scale and palet.

Species 3, confined to North America, principally in the eastern and southern portions.

Key to the Species.

Flowering scale one third or more as broad as long, with a shorter straight awn 3 mm. or less long.
  Lobes of the flowering scale rounded or truncate at the irregularly and minutely toothed apex; awn less than 2 mm. long. 1. *T. purpurea.*
  Lobes of the flowering scale acute or acutish at the apex; awn 2.5–3 mm. long. 2. *T. intermedia.*

Flowering scale one fifth as broad as long, its lobes acuminate, pointed, the awn longer than the scale, 6 mm. or more in length, recurved, at least when dry.
3. *T. Americana.*

1. TRIPLASIS PURPUREA (Walt.) Chapm. Fl. South. U. S. 560. 1860.

Aira purpurea Walt. Fl. Car. 78. 1788.
Uralepis aristulata Nutt. Gen. **1**: 63. 1818.
Diplocea barbata Raf. Am. Journ. Sci. **1**: 253. 1818.
Tricuspis purpurea A. Gray, Man. 589. 1848.
Merisachne Drummondii Steud. Syn. Pl. Gram. 117. 1855.
Triplasis sparsiflora Chapm. Fl. South. U. S. 663. 1884. [2d Ed.]

Culms 2–8 dm. tall, usually less than 6 dm., simple or finally slightly branched, the lower internodes roughened with a minute pubescence, at least below the nodes, and also occasionally sparingly hirsute; nodes numerous, densely upwardly barbed with silky hairs: leaves numerous; sheaths shorter than the internodes, rough, the lower ones sometimes papillose-hirsute at the base; ligule a dense ring of hairs less than 1 mm. long; blades erect or ascending, flat, or involute when dry, less than 15 cm. long, 1–3 mm. wide, rough on both surfaces, the upper surface usually sparingly hirsute, the uppermost leaf reduced to a point: panicle at length exserted, the axis smooth and glabrous, the roughened branches in 1's or 2's, finally widely spreading, 4 cm. or less long, the lower ones usually divided: spikelets on short hispidulous pedicels, usually purple: scales 4 or 5; outer empty 2 acuminate, the first about two thirds as long as the second, which is 3–4 mm. long; flowering scales divided about one quarter way down, the lobes rounded or truncate at the irregularly and minutely toothed apex, the awn equalling or a little exceeding the lobes, pilose on the lower half, less than 2 mm. long, the lowest scale about 4 mm. long, 1.75 mm. wide when spread out: palet shorter than the scale: grain about 2 mm. long.

In sandy soil, usually along the coast, Ontaria to Florida, west to Texas; also along the Great Lakes and from Missouri and Nebraska southward.

The *T. sparsiflora* of Chapman appears to us to be but a form of this species. Mr. C. D. Beadle, Curator of the Biltmore Herbarium, kindly sent us for examination the type specimen. It proves to be a smut-infested plant and therefore a very unsatisfactory one to determine properly, its scales necessarily being abnormal. The whole plant has a very odd look, the inflorescence appearing to be a long narrow panicle. A more careful examination, however, reveals the cause of this unique inflorescence in the breaking away of the upper sheaths, thus exposing the secondary and usually concealed panicles, which are present in the late stage of the species of this genus. This is clearly indicated by the swollen pubescent nodes which occur throughout its length. So far as can be judged from the imperfect condition of the plant, the type specimen, as indicated previously, appears to be but a form of *T. purpurea*, and, for the present at least, its disposition under this species seems to us best. Good specimens may be secured later, and then a correct valuation can be placed upon it. The specimen was collected on the "Sea beach at Punta Rosa, Florida, October, 1875."

2. TRIPLASIS INTERMEDIA sp. nov.

Culms densely tufted, 4–8 dm. tall, slender, smooth, more or less hirsute below with appressed or ascending hairs, simple or at length somewhat branched at the lower nodes; nodes numerous, densely and conspicuously upwardly barbed with silvery hairs: leaves numerous; sheaths from one half to three quarters as long as the internodes, very rough, papillose-hirsute towards the base with long ascending hairs; ligule a dense ring of hairs 1 mm. or less long; blades erect or ascending, 13 cm. or less long, the uppermost one reduced to a mere point, involute when dry, very rough on both surfaces and on the margins, hirsute above and sometimes also sparingly below, scantily papillose-ciliate with very long hairs: panicle at length exserted, the branches in 1's–3's, usually in pairs, finally widely spreading, pubescent at the base, rough, the longer ones 2–4 cm. long and more or less divided: spikelets on short pubescent pedicels, 8–10 mm. long, usually purplish: scales 5 or 6, the sixth when present empty; outer 2 empty scales acuminate, rough on the keel, about equal in length, or the first considerably shorter than the second, which is 4–4.5 mm. long; flowering scales divided from one quarter to one third their length, the lobes acute to somewhat obtuse, the callus subulate, about one half as long as the rachilla internodes, the hairs on the lateral nerves about .5 mm. long, much longer than those on the midnerve, the awn 2.5–3 mm. long, straight, much exceeding the scale, the lowest scale about 4.5 mm. long, 1.5 mm. wide; palet about three quarters as long as the scale: stamens purple, 1.75–2 mm. long.

Dry sandy soil, south peninsular Florida. Collected by the writer at Ballast Point, near Tampa, in the vicinity of the Pavillion, on August 20, 1895, no. 2426. It grew in great abundance about one hundred feet from the shore, forming large dense tufts.

3. TRIPLASIS AMERICANA Beauv. Agrost. 81, *pl. 16. f. 10.* 1812.
Uralepis purpurea Nutt. Gen. **1**: 62. 1818.
Uralepis cornuti Ell. Bot. S. C. & Ga. **1**: 580. 1821.

Culms 3–8 dm. tall, slender, smooth, puberulent, the lower internodes also hirsute with nearly appressed hairs, simple; nodes numerous, sparingly, if at all, barbed: leaves numerous; sheaths much shorter than the internodes, smooth, the lower ones hirsute, often sparingly so, with nearly appressed hairs; ligule a scarious ciliolate ring less than .5 mm. broad; blades flat, usually involute when dry, erect or ascending, 15 cm. or less long, less than 2 mm. wide, the uppermost leaf reduced to a point, rough on the margins, smooth on both surfaces, glabrous beneath or with a few long scattered hairs, the upper surface minutely pubescent, sometimes also with scattered long hairs: panicle at length exserted, the axis smooth and glabrous, the branches ascending, single or in pairs, glabrous, somewhat scabrous, simple or sparingly divided, 3 cm. or less long: spikelets on short hispidulous pedicels, usually purple, the callus subulate, about two thirds as long as the rachilla internodes: scales 4 or 5; outer empty 2 acuminate, the first three quarters or more as long as the second which is 3–4 mm. long; flowering scales divided to the middle, the lobes subulate, acuminate, pointed, the awn much exceeding the scale, usually reflexed, at least when dry, pilose for about two thirds its length, 6–8 mm. long, the lowest scale about 5 mm. long, about 1 mm. broad: palet a little more than one half as long as the scale: grain about 2 mm. long.

Dry sandy soil along the coast, North Carolina to Florida, west to Texas.

The Publications of the Department of Botany, Columbia University, consist of Memoirs in quarto and Contributions in octavo.

The Memoirs already published are:—

Vol. I. **Small.** A monograph of the North American species of the genus *Polygonum.* pp. 178. 84 plates. 1895. Price, six dollars.

Vol. II. **Rydberg.** A monograph of the North American Potentilleæ. pp. 224. 112 plates. 1898. Price, six dollars.

The Contributions have now reached the seventh volume.

Vol. I. Nos. 1–25 (1886–1892). Out of print, except Nos. 6, 7, 11, 17, 20, 21, 22, 24. These can be supplied at twenty-five cents each, except No. 6, which is one dollar.

Vol. II. Nos. 26–50 (1892–1894). Nos. 26, 28, 29, 32, 33, 34, 36, 39 and 48 are out of print. Other numbers can be supplied at twenty-five cents each, except No. 35, which is one dollar and a half.

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Vol. V. Nos. 101–125 (1896–1897). Five dollars; single numbers twenty-five cents, except No. 119, fifty cents.

Vol. VI. Nos. 126–150 (1897–1898). Five dollars; single numbers, twenty-five cents, except Nos. 129 and 143, fifty cents.

Vol. VII. No. 127—(current).

Lists of titles of Contributions may be had on application.

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. ~~110~~ 152

STUDIES IN THE BOTANY OF THE SOUTHEASTERN UNITED STATES.—XV

BY JOHN K. SMALL

NEW YORK
1898

[Reprinted from BULLETIN TORREY BOTANICAL CLUB, **25**: *605-621.* 17 D. 1898.]

Studies in the Botany of the Southeastern United States.—XV.

By John K. Small.

I. NOTEWORTHY SPECIES.

Smilax Morongii.

Smilax megacarpa Morong, Bull. Torr. Club, **21**: 434. 1894.

The specific name under which this characteristic plant was first described was preoccupied* at the time of its publication. Henceforth the species may be designated by the name of the original describer.

Baptisia megacarpa Chapm.; T. & G. Fl. N. A. **1**: 376. 1838.

During the summer of 1895, I found this local species abundantly scattered through swamps of the Flint River below Albany, Georgia. The plants there continued to flower after they had produced mature fruit. The trees forming the woods of the part of the river swamp in which this *Baptisia* grew were almost exclusively magnificent specimens of *Acer Floridanum.*

Euphorbia apocynifolia Small, Bull. Torr. Club, **25**: 467. S. 10, 1898.

Euphorbia corollata, *θ apocynifolia* Millspaugh, Bot. Gaz. **26** 268. O. 15, 1898.

Since the publication of this species excellent specimens have reached the herbarium of the New York Botanical Garden, through the National Museum. They were collected at Meridian, Mississippi, on October 10, 1896, by Mr. Charles Schuchert. They are almost exactly like the type and possess all the characters that separate the species so obviously and abundantly from its relatives.

Ceanothus serpyllifolius Nutt. Gen. **1**: 154. 1818.

In the latest interpretation† of this species the author cites a single collection, the original. The species was first collected by

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*A. DC. in DC. Monog. Phaner. **1**: 186.

† Syn. Fl. N. A. **1**: Part 1. Fascicle 2, 410. 1897.

Dr. Baldwin, near St. Mary's, in southeastern Georgia, in the early part of this century. As far as I can learn the species was not met with in the field since the time of the original collection, until Mr. Lewton found handsome specimens of it about Lake Brantley, Orange County, Florida, on July 10, 1894. It is interesting to get the species from a point several hundred miles south of the original station.

SIDA RUBROMARGINATA Nash, Bull. Torr. Club, **23**: 102. 1896.

This excellent species was collected many years ago by Rugel. I find a specimen of it in the Columbia University Herbarium, the label bearing the following record: Ad vis, prope Tallahassee, Florida, legit Rugel, Mai, 1843.

CROTONOPSIS SPINOSA Nash, Bull. Torr. Club, **22**: 157. 1895.

Mr. Lewton found this lately described species abundant in Orange County, Florida, during the summer of 1894. This collection makes the fourth known locality for the species.

CITRULLUS CITRULLUS (L.).

Cucurbita Citrullus L. Sp. Pl. 1010. 1753.

Citrullus vulgaris Schrad. Linnaea, **12**: 412. 1838.

This foreign and widely cultivated species has now become sufficiently well established in waste grounds, along railroads and in similar places to be recognized as a part of our introduced flora. I have collected it at many points in Georgia and North Carolina.

II. HITHERTO UNDESCRIBED SPECIES.

MELANTHIUM DISPERSUM.

Perennial, glabrate below the inflorescence. Stems erect, 6–12 dm. tall, simple below the panicle, thence zigzag and scurfy pubescent, rather slender: leaves without distinction between blade and petiole, narrowly linear, elongated, 3–8 dm. long, sheathing the stem for several centimeters: panicle ample, open; branches zigzag, widely ascending or spreading: bracts 3–10 cm. long, obtuse: pedicels spreading, 8–12 mm. long, rigid: perianth scurfy without, 12–15 mm. broad; segments thickish; blades oblong, obtuse, with 2 glands at the bases, entire, several times longer than the claws: capsules (barely mature) ovoid, 7–9 mm. long.

In woods, western Florida, summer.

Near to *Melanthium Virginicum* but with a different aspect, the leaves are longer and narrower and the panicle, instead of being narrow and with an elongated central axis, is broad, with few corymbosely arranged widely ascending branches and no prolonged main axis. On comparing *Melanthium dispersum* with specimens of *Melanthium Virginicum* from Florida and the Northern States, in addition to the above cited characters, we find the pedicels to be much stouter, and much more widely separated, the flowers less crowded, there being only about one half as many to each panicle and the segments of the perianth with shorter claws.

The specimens on which the species is based were collected by Mr. A. H. Curtiss in Walton county, Florida, in 1885.

SMILAX TENUIS.

Perennial, unarmed. Stems herbaceous, elongated, apparently 1 meter long or longer, commonly simple, slender, glabrous: leaves rather few; blades thin, triangular-ovate, 5–9 cm. long, acuminate, coarsely erose-denticulate, 5-nerved, with an inconspicuous sprinkling of minute hairs beneath, truncate at the base: petioles slender, as long as the blades or shorter: tendrils few, filiform, sometimes developed from the sheaths of the upper leaves: peduncles as long as the subtending leaves or longer, nearly filiform: pedicels (staminate) 15–25, 6–8 mm. long: perianth greenish; segments oblong or linear-oblong, 2.5 mm. long: filaments barely twice as long as the anthers.

In woods, Louisana. Spring.

The nearest described relative of *Smilax tenuis* is *Smilax peduncularis*, but the two species differ conspicuously in habit, the former is quite robust while the latter is very slender. The triangular-ovate leaf blades with their truncate bases and delicate nerves form a strong contrast with the larger, broader and thicker leaf blades of *Smilax peduncularis*, with their cordate bases and very stout prominent and more numerous nerves. The perianth of the newly described species is barely one half as large as that of its relative. The original specimens were collected by Dr. Hale, many years ago in Louisiana.

SMILAX DIVERSIFOLIA.

Perennial, unarmed. Stems herbaceous, 1–3 meters long, climbing, simple or sparingly branched, purplish: leaves numerous; blades ovate or oval-ovate except those accompanying the peduncles, 3–5 cm. long, tipped with an abrupt slightly twisted point, dark green above, pale and minutely pubescent on the nerves and veins beneath, prominently 3-nerved and usually with 2 more indistinct nerves, truncate or subcordate at the base; blades of leaves accompanying the peduncles lanceolate, acuminate: petioles slender, one third to one half as long as the blades: tendrils filiform, developed at the majority of the nodes: peduncles stout, twice or thrice as long as the leaves: pedicels (pistillate) 20–25, 8–10 mm. long, slightly thickened upward: berries subglobose, about 5 mm. in diameter.

In river swamps, Georgia. Spring.

During the spring of 1895, I discovered a curious species of *Smilax* growing in the river swamps of southwestern Georgia, especially in the swamps along the Flint river. It is related to *Smilax herbacea*, but it is more slender and delicate. The leaves are characteristic, the blades are much smaller and more rounded except those accompanying the peduncles; these are wholly different in shape from the other leaf-blades, being lanceolate or narrowly lanceolate. The peduncles are conspicuously elongated and fully twice as long as the accompanying leaves. The original specimens were collected by the writer along the Flint river near Albany, Georgia, May 24–28, 1895.

SMILAX RENIFOLIA.

Perennial, shrubby, glabrous. Rootstocks not seen: stems elongated, climbing high over shrubs and trees, more or less distinctly angled: leaves numerous; blades reniform or deltoid-reniform, 3–7 cm. long, resembling those of *Celtis*, rounded and mucronate at the apex, entire, mostly broader than long, subcordate at the base: petioles 5–10 mm. long; stipular sheath fully half as long as the petioles, usually furnished with tendrils: peduncles of pistillate plants 10–20 mm. long, flattened, much longer than the petioles: pedicels 16–25, 2–3 mm. long: perianth greenish; segments linear or linear-oblong, 2 mm. long, acutish: berries black, subglobose.

Along streams, Texas. Spring.

This Texan *Smilax* is remarkable for its broad *Celtis*-like leaf-blades. These alone furnish a ready means of separating it from *Smilax rotundifolia* with which it has been confused.

The specimens from which the above description is taken were collected by Mr. A. A. Heller along Bear Creek, Kerr county, Texas, on April 30, 1894, no. 1679.

SMILAX CINNAMOMIIFOLIA.

Perennial, glabrous. Stems high-climbing, sometimes 10–15 meters long, sparingly armed with slender spines, terete or nearly so: leaves alternate; blades lanceolate or ovate-lanceolate, those on vigorous shoots ample, normally 7–10 cm. long, acute or apiculate, entire, glaucous beneath, cuneate to truncate at the base: petioles 5–10 mm. long; stipular sheath about half as long as the petioles, usually furnished with tendrils: peduncles much longer than the petioles, slender, sometimes 4–5 cm. long at maturity: pedicels 5–10, 6–12 mm. long: perianth greenish; segments linear-oblong or slightly broadened upward, 4 mm. long: anthers mostly longer than the filaments: berries subglobose, about 10 mm. in diameter, bluish-black, lustrous under the glaucous coating.

In woods and rich soil, Alabama and Western Florida to Texas. Spring.

Smilax cinnamomifolia is a southern homologue of *Smilax glauca*, which species it resembles in habit. The leaf-blades are narrower, at maturity often resembling those of *Smilax lanceolata* and suggesting leaves of species of *Cinnamomum*. The upper surface is much more lustrous than that of the leaf-blades of *Smilax glauca* and the berries conspicuously large, commonly twice the size of those of *Smilax glauca*. The following specimens belong here:

Arkansas: Spirit Lake, Texarkana, *Heller*, no. 4109.
Alabama: Auburn, Lee County, November, 1895, *Underwood.*

GYROSTACHYS CONSTRICTA.

Perennial from coarse roots. Stems erect, 3–4 cm. tall, stout, simple: leaves mainly on the lower part of the stem, these linear or narrowly linear-spatulate, 1–2 dm. long, acute, narrowed into margined petioles; those higher up on the stem reduced to sheathing scales: spikes 5–10 cm. long, 2–2.5 cm. thick, closely flowered: bracts lanceolate, as long as the flowers or shorter, acuminate: lip 7–10 mm. long, nearly as long as the sepals and petals, constricted above the middle tip; ovate or deltoid-ovate, much shorter than the base; base ovate, with 2 more or less incurved basal callosities.

In marshes, Louisiana. Fall.

A distinct species related to *Gyrostachys vernalis* but more robust and larger in all its parts. The leaf-blades are much broader and the dilated tip of the lip ovate with a more or less strongly truncate base as compared with the oval or suborbicular tip of the lip in *Gyrostachys vernalis*. The original specimens were collected by Dr. Hale in marshes, Louisiana, no. 444. There is a specimen of this species in Dr. Torrey's herbarium, collected by Prof. L. C. Beck, but no locality is given on the label.

GYROSTACHYS REVERCHONII.

Perennial, light green, 3–6 dm. tall: leaves few; blades various, those of the basal and lower stem leaves linear or slightly broadened upwards; those of upper stem-leaves linear, 1–2 dm. long, acute or acuminate, reduced to sheathing bracts high up on the stem: spike long, about 1.5 cm. thick: bracts often as long as the flowers: perianth whitish; lateral sepals free, acutish; petals obtuse: lip rhombic ovate, 6 mm. long, obtuse, surpassed by the sepals and perianth, slightly crisped near the apex: callosities stout, slightly curved, pubescent at the base.

On damp prairies, Louisiana and Texas. June.

Gyrostachys Reverchonii is the Texan homologue of *Gyrostachys brevifolia*. The two species are related by the rhombic-ovate lip which is common to both. The Texan species is more robust than *Gyrostachys brevifolia* and its stem is more leafy. The following specimens should be referred here:

Texas: Prairies, Lancaster, Dallas County, June, *Reverchon* [Curtiss, N. A. Plants, no. 2788*].

Louisiana: Damp places, May. *Hale*.

GYROSTACHYS TRILOBA.

Perennial from several cord-like roots. Stems erect, 3–5 dm. tall, slender, sometimes rather weak: leaves mainly near the base of the stem, these oblong or elliptic-oblong, 3–8 cm. long, acute, sheathing at the base, upper stem-leaves reduced to sheathing scales: spikes 4–8 cm. long, about 1.5 cm. thick: bracts lanceolate acuminate, shorter than the flowers: lip oblong, 6 mm. long, about equaling the sepals and petals in length, recurved and 3-lobed at the tip, crisped throughout, cordate with 2 basal callosities.

In sand, Fort Meyer, Florida. Winter.

The species here described bears but little resemblance to any of its relatives, differing considerably in aspect by the oblong or elliptic-oblong leaf-blades. However, the crucial character that separates it from all of its relatives is the three-lobed lip. The original specimens were collected by Mr. J. H. Simpson, at Fort Meyer, Florida, December 11, 1891, no. 368.

OXALIS HIRSUTICAULIS.

Perennial from horizontal rootstock, bright green. Stems erect, 1–2 dm. tall, simple or nearly so, stout, densely hirsute, scaly at base: leaves rather numerous; petioles usually 4–10 cm. long, villous-hirsute: leaflets 3, strigillose or glabrate in age, 1–1.5 cm. long, sharply notched, thickish; peduncles erect or nearly so, surpassing the subtending leaves, pubescent like the petioles, topped by umbel-like cymes: pedicels usually 2, 1.5–2 cm. long, subtended by narrow bracts: sepals 5–6 mm. long, various; outer oblong, inner linear-oblong, all ciliate, thin, obtuse: petals golden yellow, 1.5–2 cm. long, glabrous throughout: filaments pubescent: styles villous-hirsute: capsules columnar, about 1 cm. long: seeds 1.5 mm. long, with low, transverse ridges.

In open woods, near Nashville, Tennessee.

For several years I have hesitated to publish this excellent species although to thrust it into any of the species to which it is related does violence to the clear lines separating those species from one another. On the one hand it is related to *Oxalis macrantha*, but differs in its upright habit and the copious spreading pubescence, on the other hand it can be compared with *Oxalis recurva*, but it is very much more robust, its pubescence is of a hirsute type rather than villous, then, too, the inflorescence does not conspicuously surpass the leaves and the styles are not recurved in the characteristic manner in which those of *Oxalis recurva* are.

The original specimens were collected by Dr. A. Gattinger in the vicinity of Nashville, Tennessee. Besides specimens in the Herbarium of Columbia University I have had the use of ample specimens from the Herbarium of the University of Tennessee, through Professor S. M. Bain.

OXALIS BUSHII.

Perennial by horizontal rootstocks, bright green. Stems erect, 1–2 dm. tall, nearly simple, pubescent with spreading hairs: leaves few; petioles slender, pubescent near their bases like the stem; leaflets 3, 1–1.5 cm. long, sharply notched, strigose or glabrate: peduncles slender, nearly erect, solitary or usually so, overtopping the leaves, glabrous except near the base, topped by umbel-like cymes in which 1 or 2 flowers mature at a time; these accompanied by several drooping buds: pedicels appressed pubescent: sepals oblong, 3.5–4 mm. long, obtuse, ciliolate: petals light yellow, 8–10 mm. long, emarginate or rounded at the apex: filaments much dilated at the base: styles slightly pubescent: capsules not seen.

In dry soil, Missouri and Arkansas. Spring and summer.

As in the case of *Oxalis hirsuticaulis*, I have hesitated several years before publishing the above described species in the hope that some other solution of the problem of its disposal might present itself. The species is so distinct that it is impossible to include it under any species thus far described. *Oxalis recurva* is its nearest relative and it somewhat resembles that species in its young stage, but it is much more fleshy and the stems are not tufted on the rootstocks. The short obtuse sepals and the pale yellow corollas form quite a contrast with the fully thrice larger golden-yellow corollas of *Oxalis recurva.*

The original specimens were collected by Mr. B. F. Bush in Jackson County, Missouri, June 28, 1893, no. 30.

OXALIS PRICEAE.

Perennial from slender creeping rootstocks. Upper part of the stem, petioles, peduncles and pedicels pubescent with very delicate spreading hairs. Stems erect, soon becoming decumbent, 1–3 dm. long, wire-like, more or less branched: leaflets 3, digitate, obcordate, deep green above, pale or glaucescent beneath, 6–9 mm. long, ciliate: peduncles slightly longer than the petioles or shorter, pedicels about as long as the corolla, deflexed at maturity: sepals linear or nearly so, 7 mm. long, pubescent at the base and the tip: petals deep yellow chrome, about 1.5 cm. long, finely pubescent without, ciliate, rounded or truncate at the apex: styles (in plants examined) 6–7 mm. long, densely villous: capsule columnar, 10–15 mm. long.

In open woods, middle Kentucky. Summer and fall.

A remarkable species related to *Oxalis recurva* and *Oxalis macracantha.* It resembles the latter species in habit and in the color of the foliage, and like it, the inflorescence is not elevated above the leaves, but the pubescence is spreading. The pubescence is similar to that of *Oxalis recurva* but much more delicate, the flowers too resemble those of that species in aspect, but the styles are erect. The most peculiar character is the pubescent and strongly ciliate petals. I do not know that this character exists in any of our many yellow-flowered species. Miss Sadie F. Price, for whom this *Oxalis* is named, has furnished me with copious material from near Bowling Green where she has observed this and other interesting species in the field for several years.

PHYSOSTEGIA DIGITALIS.

Perennial, glabrous below the inflorescence. Stems erect, 7–12 dm. tall, stout, sharply 4-angled: leaves opposite; blades leathery oblong to elliptic-oblong, 10–22 cm. long, acute or acutish at the apex, undulate or repand-serrate above the middle, sessile and partly clasping at the base: racemes simple or branched, finely pubescent: bracts lanceolate or ovate-lanceolate, 4–6 mm. long: pedicels very short: calices 8–10 mm. long; tubes turbinate or cylindric-turbinate; segments lanceolate, acuminate, about one half as long as the tube: corollas barely puberulent along the back, 2–2.5 cm. long; tube rather abruptly dilated into the throat; lower lip spreading, lobes oblong, middle one emarginate, about twice as large as the lateral ones; upper lip slightly undulate.

In low grounds, Louisiana. Summer and fall.

Few specimens of this species have reached our herbaria. The plants are more robust than those of *Physostegia Virginiana* and the large broad entire or merely repand-toothed leaf-blades form a conspicuous contrast with those of the common species. A comparison of the flowers of the two species under consideration shows the calyx of the newly described one to be larger and the corolla smaller than the corresponding members in *Physostegia Virginiana*. The original specimens were collected many years ago in Louisiana. The one was gathered on prairies by Mr. Carpenter while the other is from Alexandria, collected by Dr. Hale.

EUPHORBIA OLIVACEA.

Perennial, olive green, glabrous. Stems solitary or several together, 2–7 dm. tall, simple or branched at the base; branches erect or ascending, forking above or topped by a 4-rayed umbel; leaves alternate below the umbel; blades leathery, oblong, obovate-oblong or cuneate, 1–3 cm. long, obtuse or notched at the apex, with a stout midrib, sessile or short-petioled: involucres scattered along the slender branchlets, campanulate, with a truncate base about 1 mm. high, angled at maturity: glands transversely oblong, about 0.5 mm. broad; appendages ascending, white, 1 mm. long, orbicular-cuneate, minutely erose at the top.

In sandy soil, southern Mississippi. Summer.

Related to *Euphorbia apocynifolia* but the foliage is perfectly glabrous and the stems very rigid. The plants are conspicuous on account of the numerous leaves on the stem and the many small thick broad bracts scattered on the elongated branches of the inflorescence. A good character is furnished by the involucres; these are truncate at the base. I am not aware that this character exists in any other member of the group. The original specimens were collected by Prof. S. M. Tracy at Biloxi, Mississippi on July 15, 1894, nos. 2883 and 2885.

EUPHORBIA ERIOGONOIDES.

Perennial, deep green, glabrous. Stems several or many together, 1–3 dm. long, diffusely branched into a rounded head 1–3 dm. in diameter; branches very slender, zigzag, widely dichotomous, ultimate divisions nearly filiform: leaves opposite, above first fork, reflexed or deflexed; blades linear or linear spatulate, .5–1.5 cm. long, obtuse or acutish, entire, barely petioled: peduncles filiform, 3–8 mm. long at maturity: involucres campanulate with a rounded base, less than 1 mm. high, erect or ascending: glands reniform, about 0.5 mm. broad; appendages ascending, reniform-cuneate, white or pink, about 1 mm. broad, 0.5 mm. long, longer than the gland, some truncate, some cleft: capsules not seen.

In loose sand, eastern Georgia. Spring and summer.

A very characteristic species on account of its close resemblance to *Eriogonum cernuum* and some of its relatives. The stems are diffusely branched from the base and the branches thence widely dichotomous. The leaves at the nodes are reflexed or deflexed and often curved. The very numerous involucres are less than 1 mm. high, while the white or pink appendages are only about 0.5 mm. long and about 1 mm. broad. The small size of the members of the inflorescence and the characteristic habit separate it from all other species of *Tithymalopsis*. The original specimens were collected by the writer in the sands about Darien Junction, in eastern Georgia, June 25–27, 1895.

EUPHORBIA ZINNIIFLORA.

Perennial, dark green. Stems usually solitary, erect, 3–5 dm. tall, with a few ascending branches below the 3-rayed umbel, pubescent with short scattered hairs: leaves alternate except those subtending the umbel; blades narrowly linear-lanceolate, or nearly linear, 2–5 cm. long, mostly reflexed or deflexed, acute or rather obtuse, sparingly pubescent above or glabrate beneath, somewhat revolute, nearly sessile or with somewhat hairy petioles less than 1 mm. long: peduncles slender, erect, 1–3.5 cm. long, angled especially above: involucres campanulate, 1.5–2 mm. high, angled: glands oblong-reniform, fully 1 mm. broad; appendages spreading, white or pink, suborbicular or 4-sided, 3–3.5 mm. long, barely as broad, rounded or emarginate at the apex.

In sandy soil, Yellow River valley, Georgia. Spring.

While collecting in the Yellow River valley in middle Georgia during the spring of 1895, I encountered a curious looking *Euphorbia*, growing in the sands of the river swamp. The habit of the species is peculiar, the few branches of the main stem and the rays of the main umbel are terminated by several-rayed-umbels with narrow spreading leaf-life bracts. The rays of these ultimate umbels are filiform, or nearly so, and characteristically elongated. The leaves are conspicuous on account of their reflexed or deflexed position. As compared with *Euphorbia eriogonoides*, the involucres of this species are very large, sometimes measuring one centimeter across the appendages and closely resemble in aspect the heads of species of *Zinnia*. The body of the involucre differs from that of most other, if not all members of the subgenus *Tithymalopsis* in being broader than high.

EUPHORBIA PERGAMENA.

Biennial or perennial, glaucescent. Stems branched at the base; branches slender, wire-like, 0.5–1.5 dm. long, glabrous or nearly so, forking; leaves opposite; blades parchment-like, oblong or ovate, very oblique, 3–6 mm. long, obtuse, serrulate, minutely pubescent on both sides, conspicuously inequilateral, cordate or subcordate at the base, short-petioled: involucres campanulate, 1–5 mm. high, minutely pubescent, with a split on one side through which the pedicel protrudes: glands transversely oblong, purple or red-purple, variable in size, about 0.5 mm. broad; appendages white or pink, as long as the glands or longer, one much longer than the others, more or less uneven along the edges: capsules about 1 mm. high, minutely pubescent: seeds less than 1 mm. long, faces transversely wrinkled.

In sand, peninsular Florida.

The specimens on which the above described species is founded were collected in peninsular Florida by both Dr. Garber and Mr. Simpson, and were both distributed under the name of a species to which they are rather remotely related and bear but slight resemblance. The nearest relative seems to be *Euphorbia prostrata.* The newly described species can easily be distinguished by the much stouter root and more numerous and wiry branches. The leaves are conspicuously parchment-like and not fleshy; in short, the plants belonging here have a dry and rigid texture as compared with the fleshy and flaccid herbage of their relatives.

The following specimens are referred here; Florida: Miami, November, 1878, *Garber;* Lemon City, March 2, 1892, *Simpson,* no. 523.

HYPERICUM APOCYNIFOLIUM.

A branching shrub 4–7 dm. tall with a red somewhat shreddy bark. Branchlets narrowly 4-winged: leaves bright green; blades oblong or slightly broadest near the middle, 2–4 cm. long, rounded or emarginate at the apex, rarely revolute, pale beneath, minutely punctate, more or less cuneate at the base, nearly sessile: flowers 3–5 in terminal cymes: sepals spatulate, elliptic or oval, 3–5 mm. long, fully one half as long as the petals, obtuse or acutish, persistent: petals yellow, oblong, 8–9 mm. long: capsules oblong-conic, 12–13 mm. long, acute: seeds cylindrical or slightly constricted about the middle, barely 2 mm. long, minutely but conspicuously reticulated.

In swamps, Arkansas and Texas. Summer.

Probably most if not all of the Texano-Arkansas *Hypericum nudiflorum* may belong to the above descriped species. *Hypericum apocynifolium* is related to *Hypericum nudiflorum* but it is rigidly distinct. The best diagnostic characters are to be found in the flowers, these are somewhat larger than those of the eastern relative. The sepals are fully one half as long as the petals, while the capsules are 12–13 mm. long, being of a narrower pattern and fully twice as large as those of the species with which it has been confused. My attention has recently been recalled to this species by specimens collected near Texarkana during the closing season.

The species was also collected in Arkansas many years ago by Dr. Leavenworth.

GAURA FILIFORMIS.

Perennial, finely canescent. Stems erect or ascending, 1–2.5 m. tall, widely and often diffusely branched above; branches very slender, sometimes nearly filiform: leaves numerous but not conspicuously so; blades linear to narrowly linear lanceolate, 2–10 cm. long, or shorter on the branches, acute or acuminate, rather sharply but remotely serrate or entire towards the inflorescence: spikes elongated and interrupted: calyx puberulent; tube 7–8 mm. long; segments longer than the tube: petals pink-purple, oblong with a narrowed base, about 7 mm. long, obtuse: filaments 5–6 mm. long: anthers 4 mm. high: style surpassing the filaments: fruit narrowly elliptic, 6 mm. long, sessile, canescent, faces slightly ridged.

In sandy banks, Arkansas and Louisiana. Summer and fall.

Related to *Gaura angustifolia*, but very much larger, commonly reaching a height of two and one half meters and copiously and diffusely branched throughout. The narrower acuminate almost entire leaf-blades, the closer pubescence, the pink-purple corollas and the smaller fruit all serve to separate the newly described species from *Gaura angustifolia*.

The specimens on which the species is based were collected by Mr. A. A. Heller, near Texarkana, Miller County, Arkansas, August, 1898, no. 4138. The species is also represented in the Herbarium of Columbia University by a specimen collected many years ago in Louisiana, the label accompanying the specimen contains the following record: "Prairies. Fel[iciana] and Op[elousas]. Sept. 5th. Wm. C[arpenter].

VERBENA HALEI.

Annual, slender. Stems erect, 2–9 dm. tall, 4-angled, glabrous or strigillose above, branching near the top or rarely at the base: leaves strigillose, 3–10 cm. long; blades various, those of the basal and lower stem leaves oblong to ovate, irregularly toothed and incised, long-petioled, those of middle part of stem commonly broader, 1–2-pinnatifid, shorter petioled: upper ones sparingly toothed or entire: spikes slender; bracts shorter than the calyx, appressed: calyx becoming 3–3.5 mm. long, strigillose; teeth mucronate: corolla blue; tube about 3 mm. long; limb 6–7 mm. broad, segments notched: nutlets linear-oblong, about 2.5 mm. long.

In sandy soil, Indian Territory to Louisiana and Texas. Spring and summer.

Verbena Halei has the general habits of *Verbena officinalis* but differs from that species in both the leaves and inflorescence. The lower leaf-blades are usually less deeply lobed, often merely coarsely toothed, while the upper leaves or leaf-segments are conspicuously elongated and nearly entire or remotely toothed. The corollas are twice the size of those of *Verbena officinalis* and the narrow fruit often fully twice the length of that of the eastern relative. The following specimens belong here:

Louisiana: *Dr. Hale*, no. 245.

Texas: San Diego, 1885–86, *Miss Croft*, no. 119; Corpus Christi, 1894, *Mr. Heller*, no. 1419.

Indian Territory: Between Fort Cobb and Fort Arbuckle, 1868, *Dr. Palmer*, no. 242.

GERARDIA POLYPHYLLA.

Annual, smooth and glabrous or nearly so. Stems erect, 1–4 dm. tall, bushy; branches wire-like, ascending: leaves opposite, numerous; blades linear filiform or setaceous, 1–2.5 cm. long, acute, straight or somewhat curved, slightly revolute: pedicels filiform, spreading, 1–2 cm. long, surpassed by the leaves: calices 2–3 mm.; tubes turbinate; teeth triangular-subulate, one fourth as long as tube: corollas pink or pink-purple, less than 1 cm. long.

In sandy soil, Little Stone Mountain, Georgia. Summer and fall.

The species of *Gerardia* just described is related to *Gerardia setacea* Walt., but it is more delicate and all its members are smaller. All the plants that I have seen are conspicuously much branched and the small corollas and the large calyx-teeth which are fully one fourth as long as the turbinate tube easily separate the species from any forms of *Gerardia setacea* with which I am acquainted.

The original specimens were collected by the writer on Little Stone Mountain, DeKalb County, Georgia, in September, 1895. Specimens which without much doubt will have to be referred here have now been brought in by Mr. Heller from the vicinity of Texarkana, Arkansas, no. 4219. These are almost identical with the Georgia plants.

GERARDIA VIRIDIS.

Annual, slightly scabrous, drying green. Stems erect, 2–6 dm. tall, branching, sharply angled: leaves opposite or slightly scattered; blades narrowly linear, 1–2 cm. long, acute, revolute, scabrous along the edges, sessile or nearly so: pedicels ascending, 8–15 mm. long, as long as the leaves or shorter, slender: calices 4–5 mm. high; tubes turbinate to turbinate-campanulate; teeth acute, about one third as long as the tubes: corollas yellowish-pink, less than 1 cm. long; segments ciliate, truncate or barely emarginate.

In sandy soil, Arkansas to Louisiana. Summer and fall.

At least two species in addition to the type are passing under the name *Gerardia Skinneriana.* The one I have just separated in the above description can be easily recognized by the coarser habit, the larger and broader leaves and the long calyx-teeth; these form a strong contrast with the minute teeth of the calyx of *Gerardia Skinneriana.* Mr. Heller has collected excellent specimens of the species about Texarkana, Arkansas, during the past season, no. 4240. Dr. Hale found it many years a little further south at Alexandria, Louisiana.

SOLIDAGO HELLERI.

Perennial, robust. Foliage nearly glabrous: stems erect, 6–16 dm. tall, usually green mottled with purple, branched above into wide spreading panicles: leaves numerous; blades narrowly elliptic or oblong-elliptic, 3–10 cm. long, acute, serrate with appressed teeth at least above the middle, smooth and glabrous above, sparingly pubescent beneath, ciliate, sessile or nearly so above: racemes one-sided, slightly recurved; bracts linear or linear-spatulate: involucres cylindric, about 6 mm. high, spirally twisted; bracts glabrous, erect, firm, leathery, linear or linear-lanceolate, conspicuously decurrent on the peduncle: rays 2–4, yellow, inconspicuous, partly included; blades oblong, 1–1.5 mm. long.

In sandy woods, Arkansas.

Solidago Helleri is related to *Solidago rugosa* and *Solidaga ulmifolia*, possessing the general habit of the former and in the foliage characters nearest to the latter. It differs from both relatives in its peculiar heads; these members are supported on slender peduncles, which are often copiously furnished with delicate bracts. These bracts grade into those of the involucre proper, and, like those of the involucre, are strongly spirally arranged, giving a conspicuous twist to the heads.

The plants on which the species is founded were collected by Mr. A. A. Heller, near Texarkana, Bowie County, Texas, September, 1898, no. 4188.

DOELLINGERIA SERICOCARPOIDES.

Perennial, deep green. Stem erect, 8–12 dm. tall, corymbosely branched above, finely ridged, purple or purple-mottled, glabrous to the ultimate divisions or near them; leaves numerous; blades firm, elliptic to lanceolate-elliptic, acute or slightly acuminate at the apex, somewhat scabrous above, glabrous and paler beneath or minutely pubescent on the nerves beneath, ciliate, narrowed into short petioles or nearly sessile: peduncles minutely pubescent: involucres cylindric-campanulate, about 4 mm. high, 2–2.5 mm. thick; bracts very sparingly pubescent, outer linear-lanceolate, inner linear, ciliate at the tip: rays white, 2–4, oblong, 5–6 mm. long: mature heads about 8 mm. high: achenes almost glabrous.

In low grounds, Arkansas and Texas. Fall.

The *Doellingeria* inhabiting the lower Mississippi valley is undoubtedly specifically distinct from all the recognized species. It was separated from related forms in Torrey and Gray's Flora of North America and recognized as a species by Schultz Bipontinus in the Meisner Herbarium. However, as far as I can learn, it has never been given a name. From the other species of the genus it may be distinguished by the more rigid habit and the firmer texture of the leaves, but the most characteristic distinction lies in the inflorescence; this is quite suggestive of the species of *Sericocarpus* in the ultimate clusters, but the branches of the inflorescence are conspicuously elongated. The small heads which are only about half the size of those of its relatives furnish a crucial character. The original specimens were collected by Mr. A. A. Heller, near Texarkana, Miller County, Arkansas, in August and September, 1898, no. 4137.

ASTER CONTINUUS.

Perennial, deep green. Stems erect, pubescent with short upcurved hairs, simple below, much branched above, slightly flexuous: leaves spreading; blades 2–4 cm. long, somewhat fiddle-shaped, acute, shallowly serrate or nearly entire, ciliolate, scabro-pubescent on both sides, sessile, clasping at the base: inflorescence ample; branches spreading, slender, closely pubescent, furnished with many approximate bract-like scales: heads showy: involucres turbinate, short before anthesis, elongated to 1 or 1.5 cm. at maturity: bracts numerous, linear or nearly so, acute, erect or slightly spreading, with narrow dark green tips, conspicuously decurrent on the peduncles: rays 12–15, violet, nearly linear, about 1 cm. long: achenes pubescent.

In dry soil, Arkansas. Fall.

Aster continuus is one of the more conspicuous species of the genus. Its relationship is with *Aster patens.* Differences in habit and foliage are much subornate to the very peculiar involucres. Up to about the time the rays expand these members are turbinate, but after the rays expand and the head matures the involucres become conspicuously obconic and greatly elongate. The bracts of the involucre have often a conspicuously spiral arrangement and gradually pass into those of the elongated peduncles. The original specimens were gathered by Mr. A. A. Heller, near Texarkana, Arkansas, in September, 1898, no. 4283.

III. THE PARONYCHIACEOUS GENUS FORCIPELLA.

Unfortunately the name FORCIPELLA which I lately associated with a genus of PARONYCHIACEAE was used in the family ACANTHACEAE* since the publication of the Kew Index and before my adoption of it. This being the case, I cannot do better than associate the name of the late Professor Lewis R. Gibbes, of Charleston, South Carolina, the discoverer of such conspicuous species as *Aster mirabilis* and *Tsuga Caroliniana*, and founder of an important herbarium,† with this interesting genus:

GIBBESIA.

GIBBESIA RUGELII (Chapm.).

Siphonychia Rugelii Chapm. Fl. S. States 47. 1860.

Paronychia Rugelii Shuttl.; Chapm. Fl. S. States 47. As synonym. 1860.

Forcipella Rugelii Small, Bull. Torr. Club, **25**: 150. 1898.

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* See Engler and Prantl, Nat. Pfl. Fam. 4: Abh. 3, b. 343.

† This herbarium is now incorporated in the herbarium of the New York Botanical Garden.

The Publications of the Department of Botany, Columbia University, consist of Memoirs in quarto and Contributions in octavo.

The Memoirs already published are:—

Vol. I. **Small.** A monograph of the North American species of the genus *Polygonum.* pp. 178. 84 plates. 1895. Price, six dollars.

Vol. II. **Rydberg.** A monograph of the North American Potentilleæ. pp. 224. 112 plates. 1898. Price, six dollars.

The Contributions have now reached the seventh volume.

Vol. I. Nos. 1–25 (1886–1892). Out of print, except Nos. 6, 7 11, 17, 20, 21, 22, 24. These can be supplied at twenty-five cents each, except No. 6, which is one dollar.

Vol. II. Nos. 26–50 (1892–1894). Nos. 26, 28, 29, 32, 33, 34, 36 39 and 48 are out of print. Other numbers can be supplied at twenty-five cents each, except No. 35, which is one dollar and a half.

Vol. III. Nos. 51–75 (1894–1895). Nos. 52, 54, 60 and 72 are out of print. Others can be supplied at twenty-five cents each.

Vol. IV. Nos. 76–100 (1895–1896). Five dollars; single numbers twenty-five cents each.

Vol. V. Nos. 101–125 (1896–1897). Five dollars; single numbers twenty-five cents, except No. 119, fifty cents.

Vol. VI. Nos. 126–150 (1897–1898). Five dollars; single numbers, twenty-five cents, except Nos. 129 and 143, fifty cents,

Vol. VII. No. 151—(current).

Lists of titles of Contributions may be had on application.

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Professor of Botany.

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 153

STUDIES IN THE LEGUMINOSAE.—I, II, III

BY ANNA MURRAY VAIL

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Studies in the Leguminosae.—I.

BY ANNA MURRAY VAIL.

NOTES ON MEIBOMIA.

MEIBOMIA ARENICOLA.

Hedysarum lineatum Michx. Fl. Bor. Am. 2: 72. 1803. Not of Linn. Syst. Ed. 10, 1170. 1759.

Desmodium lineatum DC. Prodr. 2: 330. 1825.

Meibomia lineata Kuntze, Rev. Gen. Pl. 196. 1891.

MEIBOMIA MICHAUXII.

Heysarum rotundifolium Michx. Fl. Bor. Am. 2: 72. 1803. Not of Vahl, Symb. 2: 81. 1791.

Desmodium rotundifolium DC. Prodr. 2: 330. 1825.

Meibomia rotundifolia Kuntze, Rev. Gen. Pl. 197. 1891.

MEIBOMIA TENUIFOLIA (T. & G.) Kuntze.

In Bull. Torr. Club, 19: 110, this species, owing to a mistake on a written label, was erroneously recorded as having been collected in Missouri. The label should have read Mississippi.

MEIBOMIA LONGIFOLIA (T. & G.).

Perennial, erect, 6 dm.–1 m. high or more; stems stout, branched, angled, striate, channelled, uncinate-pubescent mostly in lines, sometimes becoming glabrate; stipules ovate-lanceolate, cuspidate, persistent or caducous; petioles 1.5–5 cm. long, striate, pubescent; stipels 5 mm. long or more, often persisting; leaflets 5–11 cm. long, 2.5–5 cm. wide, lanceolate, lanceolate-ovate, or ovate, acuminate, slightly rugose or scabrous with few scattered hairs and becoming glabrate above, much lighter and appressed-pubescent or villous beneath, the terminal leaflet usually much larger than the lateral ones; panicles spreading flowers numerous, showy, about 1 cm. long on slender spreading uncinate-pubescent pedicels; bracts 5–10 mm. long, ovate or ovate-lanceolate, striate, ciliate, caducous; calyx 3 mm. long, the lobes attenuate, the upper one 2-toothed, the others somewhat longer; corolla lilac-purple, showy; legume 4–6-jointed, 3.5–6 cm. long, uncinate-pubescent, straight or somewhat rounded and angled on the dorsal suture, deeply triangular on the ventral, or nearly equally sinuate above and below, the 8–10 mm. long, reticulated joints almost lozenge-shaped; stipe about the length of the calyx-lobes.

June–September.

A characteristic species with the habit, leaf-form and legume of *M. bracteosa* and the pubescence of *M. Canadensis* and appearing as if intermediate between the two. The type specimen is without mature fruit.

Original locality, Arkansas. Type in Herb. Columbia University.

DISTRIBUTION. Illinois (Mead); Missouri (Bush, without fruit)? Kansas (Carleton); Arkansas (Nuttall); Louisiana (Hale); Alabama (Rugel).

SYNONYMY. *Desmodium Canadense* var. *longifolium* T. & G. Fl. N. Am. 1: 365. 1838.

Desmodium longifolium Nutt.; T. & G. Fl. N. A. l. c. as synonym.

MEIBOMIA PSILOPHYLLA WRIGHTII (A. Gray).

Desmodium Wrightii A. Gray, Bost. Journ. Nat. Hist. 6: 177. 1850.

Meibomia Wrightii Kuntze, Rev. Gen. Pl. 198. 1891.

This species is so close to *M. psilophylla* (Schlecht. Linnaea, 12: 310. 1838) as to scarcely even merit varietal rank. It is, however, variable, and the North American form seems to have somewhat broader leaves and slightly larger loment-joints.

DISTRIBUTION: Texas, New Mexico and Mexico.

M. psilophylla (Schlecht.) occurs in South Mexico.

MEIBOMIA ANGUSTIFOLIA (H. B. K.) Kuntze, Rev. Gen. Pl. 187 1891.

Hedysarum angustifolium H. B. K. Nov. Gen. 6: 517. 1823.

Desmodium angustifolium DC. Prodr. 2: 328. 1825.

Desmodium gramineum A. Gray, Pl. Wright. 2: 46. 1853.

Meibomia graminea Kuntze, Rev. Gen. Pl. 198. 1891.

Reprinted from the BULLETIN OF THE TORREY BOTANICAL CLUB, Vol. 24, No. 1, January 28, 1897.)

Studies in the Leguminosae.—II.

BY ANNA MURRAY VAIL.

NOTES ON PAROSELA, WITH DESCRIPTIONS OF NEW SPECIES.

PAROSELA ARIZONICA n. sp.

Suffruticose, 1.5–2 dm. high, branched from the base, strongly aromatic-glandular throughout, minutely cinereous-pubescent below, glabrous above; stipules minute; basal leaves on the short, old? shoots 1 cm. long or less, grayish-green, cinereous, becoming glabrate? the leaflets 5–9, linear, strongly involute, 2–3 mm. long, obtuse, beset with scattered glands; upper leaves 2–4 cm. long, yellowish-green, glabrous or nearly so, the rhachis channeled, at length falcate, leaflets 9–21, involute, 3–6 mm. long, linear, bright yellow-green, thick and coriaceous, glandular, falcate, somewhat reflexed; peduncles terminal, 1–3 cm. long; heads subglobose, 6–10 mm. long; bracts 2–3 mm. long, broadly ovate, acute, somewhat scarious, minutely pubescent, the outer ones obtuse at the base, the inner ones unguiculate, bearded on the back of the claw; calyx slightly less than 3 mm. long, membranous, contracted at the mouth, teeth minute, acute; corolla white, very small; pod 2–5 mm. long, obliquely ovoid; seed 2 mm. long, obtuse at the hilum, pale yellow.

A species remarkable for its numerous, low, erect branches, bright green upper leaves, and very small heads of white flowers. The specimens from which this description has been drawn are preserved in Herb. Columbia University, and were sent to me by Miss Alice Eastwood, and the label reads, "Vicinity of Tucson, Arizona; collected by Herbert Brown, October, 1895."

PAROSELA THYRSIFLORA (A. Gray).

Dalea thyrsiflora A Gray, Proc. Am. Acad. 5: 177. 1861.

Dalea Dominigensis var. *paucifolia* Coulter, Contr. U. S. Nat. Herb. No. 2: 34. 1890.

PAROSELA GRAYI.

Dalea laevigata A. Gray, Pl. Wright. 2: 38. 1853. Not *Dalea laevigata* Moç. & Sessé; in Don, Gen. Syst. 2: 224. 1832.

PAROSELA ELATIOR (A. Gray).

Dalea aurea var. *elatior* A. Gray, Pl. Wright. 1: 46. 1852.

Dalea rubescens S. Wats. Proc. Am. Acad. 17: 369. 1882.

Parosela rubescens A. M. Vail, Trans. N. Y. Acad. Sci. 14: 34. 1894.

Intermediate between *P. aurea* and *P. nana.* The bracts are narrower and longer than those of either of the above species, the corolla turns reddish-purple and the leaves are usually less villous.

PAROSELA WISLIZENI (A. Gray) A. M. Vail, Trans. N. Y. Acad. Sci. 14: 34. 1894.

A little-known species which shows great variation in the color of the flowers, some of them being lilac, others rose-colored and others again rose-colored with the standard ochroleucous and in the latter case closely resembling those of *Parosela lasiostachya* (Benth.), which species is glabrous throughout with somewhat fleshy leaves. *P. Wislizeni* may not be more than a pubescent form of the latter species. In Herb. Canby, preserved in Herb. N. Y. College of Pharmacy, a specimen of *P. lasiostachya* collected by Parry and Palmer, no. 15, from near San Luis Potosi shows the characteristic acute leaflets of that species, the upper ones being faintly silky villous and identical with those of some smoother forms of *P. Wislizeni.*

PAROSELA WISLIZENI SESSILIS (A. Gray).

Dalea Wislizeni var. *sessilis* A. Gray, Proc Am. Acad. 16: 105. 1880.

A very noteworthy variation. A low shrub with spreading slender branches and short racemes of showy, rose-colored flowers sessile on the short, lateral branchlets. The general appearance of the plant is that of *Parosela formosa* (Torrey), and in several instances has been confounded with it. The leaflets are very small, greyish-green, silky-pubescent or rarely glabrate, with small dark glands on the lower surface, and are not at all fleshy. The bracts are oblong or oblong-lanceolate, caducous, the keel petals are remarkable for the two linear-oblong glands in the form of a v at the apex and the short banner is pale yellow

Parosela formosa has numerous short, divaricate branches, very small, glabrous leaflets, scarious, concave, glabrous, caducous bracts, eglandulose, bright rose-purple keel petals and a pale yellow banner.

PAROSELA JAMESII (Torr.)

Psoralea Jamesii Torr. Ann. Lyc. N. Y. 2: 175. 1828.
Jamesia obovata Rafin. Atl. Journ. 145. 1832.
Dalea Jamesii Torr. & Gray, Fl. N. Am. 1: 308. 1838.

Very close to the above species is *Parosela triphylla* (Pav.) from northern and southern Mexico. It has longer and more truly decumbent or trailing stems and somewhat narrower leaflets which are invariably glabrous on the upper surface. *P. Jamesii* may be only a northern form of the Mexican plant. Here also appears to belong *Parosela prostrata* (Orteg.), of which I have not seen any specimens.

PAROSELA WRIGHTII (A. Gray).

Dalea Wrightii A. Gray, Pl. Wright. 1: 49. 1852.

Closely resembling *P. Jamesii*, from which it differs in the apparently more erect habit, the five oblong leaflets and the rose-colored flowers. A closely allied species is *P. Luisana* (S. Wats.) from the north of Mexico (Schaffner, no. 808; Parry and Palmer, no. 164). It is very low (4–6 cm.), with short decumbent stems, slender leaflets and small capitate racemes of yellow flowers. No. 162, collected by Parry and Palmer, in the same region, appears to be a very small form of *P. Wrightii* and intermediate between it and *P. Luisana*. Further collections may prove them to be but one species.

PAROSELA FREMONTII (Torr.)

Dalea Fremontii Torr.; A. Gray, Mem. Am. Acad. 5: 316. 1855.

The type specimen of *D. Fremontii*, no. 417, collected by Fremont in the "Pah-Utah" country, southwest California, May 5th, 1844, is preserved in Herb. Columbia University, and includes many specimens since distributed as *Dalea Californica* S. Wats. Proc. Am. Acad. Sci. 11: 132, 1876, the type of which is no. 86, C. C. Parry and J. G. Lemmon, from southern California, 1876.

These two species are so close as to make it doubtful that they are not the same. The leaves are identical, the greatest difference being in the calyx, which in *Parosela Californica* (S. Wats.) is smaller, more densely canescent-pubescent and more distinctly ribbed. *Parosela Fremontii* is very variable and appears to intergrade with the three following species.

PAROSELA JOHNSONI (S. Wats.)

Dalea Johnsoni S. Wats. Bot. King's Rep. 5: 64. 1871.

Differing from *P. Fremontii* mainly in the longer, narrowly linear leaflets which are only rarely decurrent on the rhachis.

PAROSELA AMOENA (S. Wats.).

Dalea amoena S. Wats. Am. Nat. 7: 300. 1876.

This species was described from some rather fragmentary specimens collected by Mrs. E. P. Thompson, near Kanab, southern Utah, and now preserved in Herb. Gray. Some similar specimens were collected in Utah by Captain Bishop in 1872, and are to be seen in U. S. Nat. Herb. at Washington. The leaflets vary from very acute to rather broadly obtuse, the three terminal ones often cohering and appearing as if variously lobed. The most marked characters are the slender, linear calyx-teeth, which are as long, or nearly as long, as the tube.

PAROSELA WHEELERI n. sp.

Apparently a low shrub; branchlets short, beset with small, scattered, elevated, prickle-like glands; leaves 3–7-foliolate, 1–2.5 cm. long, the rhachis flattish, strigose-hirsute; petioles 3–10 mm. long; leaflets 5–10 mm. long, 2–6 mm. wide, oblong to oblong-ovate, oblong-cuneate, spatulate or ovate, strigose-hirsute on both surfaces, less so above, glands small, scattered beneath, the terminal leaflet usually petiolulate, or rarely cohering with one of the lateral ones; flowers in short (2–4 cm. (?) long), few-flowered racemes; bracts not seen; calyx 5–7 mm. long, obscurely 10-ribbed, with oblong glands between the ribs, sparingly hirsute, at length glabrous, the subulate teeth ciliate, much enlarged in fruit, about the length of the tube; corolla bluish or reddish purple; legume 1 cm. or more long, obliquely oblong, glabrous or with a few scattered hairs, beset with large glands, nearly straight on the dorsal, rounded along the ventral suture, beaked by the stout base of the style; seed oblong, acutish at the base, brown.

This description has been drawn from a few fragments belonging to what appears to be a low shrub with straw-colored bark and short, almost fascicled branchlets. I have not seen any spines· but the apex of the peduncle seems to indicate a spinescent termination.

Original locality, Nevada, Wheeler expedition, 1872. Type in Herb. Columbia College and U. S. Nat. Herb.

PAROSELA THOMPSONAE n. sp.

Apparently a low shrub; branchlets short? clothed with a short, close, whitish, retrorse pubescence or tomentum and beset with scattered, somewhat elevated reddish glands, becoming glabrate with age; stipules caducous, not seen; petioles 3–5 mm. long, leaves about 1.5 cm. long, 5–7 or more foliolate; leaflets about 2 mm. long, oblong, obtuse, acutish at the base, somewhat thick, minutely strigose-hirsute on both surfaces, margins revolute, with a few dark glands beneath; racemes 3–4 cm. long, loosely-flowered, short-peduncled; bracts not seen, caducous; calyx 4 mm. long, glabrous, conspicuously 10-ribbed, with 1–3 round or oblong red glands between each rib below the sinus, the broadly triangular teeth ciliate, pubescent on the inner surface, shorter than the tube; corolla rose-purple, twice as long as the calyx, the petals with a few slender glands near the apex; legume and seeds not seen.

A species with the calyx allied to that of *Parosela maritima* (Brandegee) from Lower California, but differing in the broad, ciliate, acutish or obtuse, short calyx-teeth and the very symmetrical arrangement of the reddish glands on the ribs of the calyx-tube. The space between the two upper ribs is eglandulose, the next two spaces on either side have two glands each, one above the other, the remaining spaces having one gland each. In the very fragmentary specimens examined, this was a constant character.

Original locality, Northern Arizona.

Type collected by Mrs. Thompson, 1872.

Dalea amoena in part, in U. S. Nat. Herbarium.

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Studies in the Leguminosae.—III

BY ANNA MURRAY VAIL

I. NOTES ON THE GENUS DOLICHOLUS (RHYNCHOSIA) IN THE UNITED STATES

DOLICHOLUS Medik. Vorles. Chur. Phys. **2**: 354. 1787. [Bot. Beob. des Jahres 1783: 211. 1784.]

[RHYNCHOSIA Lour. Fl. Cochin. 460. 1790.]

[ARCYPHYLLUM Ell. Journn. Acad. Phila. **1**: 371. 1818.]

[COPISMA E. Meyer, Com. Pl. Afric. Austr. 132. 1835–1837.]*

Key to the Species

COPISMA.—Twining, usually prostrate and trailing, or rarely more erect, perennial herbs: leaves 3-foliolate, the lateral leaflets inequilateral: flowers in slender axillary racemes or few-flowered clusters: calyx marcescent, not at all foliaceous, somewhat bilabiate, deeply 4-cleft; teeth subulate, the middle one the longest: corolla exceeding the calyx-teeth.—E. Meyer.

Racemes very slender, many-flowered, exceeding the leaves; flowers and legumes reflexed. 1. *D. minimus.*
Racemes 2–6-flowered, as long as or shorter than the leaves. 2. *D. parvifolius.*
Flowers short-pedicelled, solitary, or several together in the axils of the leaves. 3. *D. Texensis.*
Racemes short-peduncled, 2–4-flowered; bracts persistent. 4. *D. Swartzii.*

ARCYPHYLLUM.—Slender, upright or elongated perennial, often twining herbs: leaves simple or 3-foliolate; lateral leaflets inequilateral: flowers in short-peduncled, axillary, few-flowered or, crowded clusters, or rarely elongated racemes: calyx 4-parted nearly to the base, persistent, the foliaceous segments linear or oblong-lanceolate, acuminate, nearly equal, the upper ones 2-toothed: corolla not exceeding the calyx-teeth.—Ell. Journ. Acad. Phila. **1**: 371. 1818.

Prostrate or climbing perennial vines.
  Leaves unifoliolate or in *D. Michauxii* rarely the uppermost trifoliolate; racemes axillary.
    Leaves reniform, cordate at base. 5. *D. Americanus.*
    Leaves reniform, truncate at base. 6. *D. Michauxii.*

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*The monotypic genus *Pitcheria*, Nutt. Journ. Acad. Phila. 7: 93. 1834, though difficult to distinguish from *Dolicholus* by any absolute characters, differs from it greatly in general appearance and habit.

Leaves trifoliolate.
Racemes very short-peduncled or sessile.
Stems prostrate; leaflets cinereous. 7. *D. cinereus.*
Stems generally climbing.
Leaflets thickish, entire, ovate-rhombic. 8. *D. tomentosus.*
Leaflets thin, the margin with a few, broad rounded undulations. *D. tomentosus undulatus*
Racemes peduncled or the uppermost short-peduncled, becoming elongated.
Prostrate; leaflets apiculate, 2.5–3.5 cm. long. 9. *D. Torreyi.*
Climbing vines.
Leaflets obovate-orbicular, thin, rounded at the broad apex, narrowed at the subcordate base. 10. *D. Lewtoni.*
Leaflets ovate or ovate-rhombic, thick, velvety-pubescent; racemes commonly much elongated. 11. *D. latifolius.*
Erect perennial herbs.
Leaves unifoliolate, reniform. 12. *D. simplicifolius.*
Leaves trifoliolate or some of the basal ones simple.
Racemes terminal and axillary, never long-peduncled and elongated.
Stems simple, 1–2 dm. high. 13. *D. intermedius.*
Stems simple or branched.
Racemes numerous, short, axillary; leaflets thick, velvety-pubescent, acutish or obtuse. 14. *D. erectus.*
Racemes numerous, short, axillary; leaflets densely velutinous, acute. 15. *D. Drummondii.*
Racemes terminal or a few of them axillary, commonly much elongated. 16. *D. mollissimus.*

1. **Dolicholus minimus** (L.) Medik. Vorles. Chur. Phys. **2**: 354. 1787.

Dolichos minimus L. Sp. Pl. 726. 1753.
Glycine reflexa Nutt. Gen. **2**: 115. 1818.
Rhynchosia Caribaea Nutt. Am. Journ. Sci. **5**: 298. 1822. Not *Glycine Caribaea* Jacq. 1786.
Glycine Lamarkii H.B.K. Nov. Gen. **6**: 424. 1823.
Glycine punctata DC. Mém. Leg. 365. 1823.
Glycine littoralis Vahl.; DC. Prodr. **2**: 385. 1825.
Rhynchosia minima DC. Prodr. **2**: 385. 1825.
Rhynchosia Caribaea DC. Prodr. **2**: 386. 1823.
Rhynchosia ervoidea DC. Prodr. **2**: 386. 1825.
Phaseolus Caribaeus Eat. & Wright. 353. 1840.
* *Rhynchosia Mexicana* Hook. & Arn. Bot. Beech. Voy. 287. 1841.

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* The synonymy given here is only that which can be applied to the American plant.

In pine woods, South Carolina to Florida, Texas and southward to Brazil.

A common plant in tropical regions. Very variable. An exceedingly small-leaved and flowered form occurs on the Florida Keys.

Type in the Linnean Herbarium.

2. **Dolicholus parvifolius** (DC.)

Rhynchosia parvifolia DC. Mém. Leg. 367. 1823.

Florida; West Indies. Apparently not common.

3. **Dolicholus Texensis** (Torr. & Gr.)

Rhynchosia Texana Torr. & Gray, Fl. N. Am. **1**: 387. 1838.

In dry soil, Texas to Arizona and North Mexico. Also in South Brazil and Argentina.

Type in the Herbarium of Columbia University.

This species has been reduced to *Dolicholus Senna* (Gillies) Kuntze (*Rhynchosia Senna* Gill. H. & A. Bot. Misc. **3**: 199. 1844). I have kept them apart here as the latter species is not very well known and will probably need further study to determine its rightful position.* There are two or even three distinct forms, of which very luxuriant ones with elongated stems and lanceolate-oblong or even linear upper leaves are *Dolicholus Texensis* var. *angustifolius* (*Rhynchosia Texana* var. *angustifolia* † Engelm. Pl. Wright. **1**: 44. 1852).

In Contribution à la Flore du Paraguay, by M. Micheli (Mem. Soc. Phys. Geneva, **28**: 1883). *Rhynchosia Texana* is maintained as distinct from *R. Senna* and a new species is described as *R. diversifolia* which apparently is very closely related to the *Dolicholus Texensis* var. *angustifolius* of North America.

4. **Dolicholus Swartzii**

Rhynchosia Caribaea Chapm. 104, 1860. Not *Glycine Caribaea* Jacquin. 1786.

A slender, somewhat twining perennial or woody vine. Stems apparently branching at the base, slightly striate, pubescent, sparingly resinous-dotted: stipules 4 mm. long, linear-lanceolate, ciliate, reflexed, at length caducous: petioles 2–6 cm. long, slender, channelled, pubescent: leaves 3-foliolate; terminal petiolule 8–12 mm. long; terminal leaflets 4–5 or 6 cm. long, ovate, long-acuminate, 3–4 cm. wide, rather thin, soft pubescent on both surfaces, resinous-dotted beneath; lateral leaflets smaller, inequilaterally ovate, commonly though not always long-acuminate: racemes 1–2 cm. long or less, 2–3 (?)-flowered, the short peduncles very slender: pedicels filiform, 3–4 mm. long, puberulent: bracts very small, persisting: calyx 3 mm. long, resinous-dotted; teeth shorter than the tube: corolla yellow, much exceeding the calyx; vexillum obovate, 8 mm. long, minutely puberulent and dotted with elevated yellow resinous dots or glands on the outside: ovary resinous-dotted, pubescent or bearded along the apex: legume 2.5–3 cm. long, 5–7 mm. wide, falcate, acute at the apex, tapering to the petiole, dark brown and coriaceous, pubescent, resinous-dotted: mature seeds 5–6 mm. long, oblong-ovoid, bright red.

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*I am much indebted to Mr. J. Henry Burkill for valuable notes on some South American material of this species in the Herbarium of Kew Gardens.

† *Dolicholus angustifolius* Kuntze, Rev. Gen. Pl. **3**: 60. 1898.

South Florida; Cuba.

My attention was first called to this species two years ago by a fragment in the Chapman Collection in the Herbarium of Columbia University, which purported to be *Rhynchosia Caribaea* DC. It was also labelled "South Florida, Blodgett." Somewhat later in looking over a large bundle of miscellaneous leguminous and mostly unnamed material in the Torrey Collection, I found a good original specimen of Mr. Blodgett's from Key West, with the following note: "Climbing high on trees. Flowers yellow, all seasons. Damp places." I concluded that it was an unnamed species, but owing to the uncertainty attached to the identity of *Rhynchosia Caribaea* (*Glycine Caribaea* Jacquin, Icon. Rar. *t. 146.* 1786), I was unwilling to undertake the responsibility of giving it a new name. Since then I have had the opportunity of examining the Jacquin plate, with which our Florida plant does not seem to have anything in common, except the shape of the legume.

Besides these two specimens, I have seen the following: Rugel, no. 137, from Key West, February, 1846, ex-Herb. Shuttleworth in the Herbarium of the British Museum, where there are also two fragments labelled "Hispaniola, Dr. Swartz." In the Kew Herbarium there is a specimen of it from Wright's collecting in Cuba, no. 2323, inscribed as *Rhynchosia Caribaea* ex-Griesb. Catal. Pl.

Cubens. and another of the same extraction is in the Herbarium of the Missouri Botanic Garden.

A duplicate of Rugel's no. 137, an excellent complete specimen, is also to be found in the Herbarium of the Museum at Paris. The Rugel specimen in the British Museum Collection bears notes to the effect that the plant climbs on shrubs and that it is rare.

I have named the species in honor of Dr. Swartz, the eminent author of the Flora Indiae Occidentalis.

As regards the true *Rhynchosia Caribaea* there is so much misunderstanding that it would be difficult to venture an opinion in regard to its identity. In the Index Kewensis *R. Caribaea Auct. Plur. ex Benth. Mart. Fl. Bras 15: part 1. 205* is referred to *R. minima*, some broader-leaved forms of which certainly do resemble the plate on which *R. Caribaea* was based. The next reference in the Index is to *R. Caribaea DC. Prodr. 2: 384. Am. Bor.; Ind. Occ.; Afr. Trop. et austr.* and in the same work such species as *R. acuminatum* Eckl. R. Zeyl., *R. gibba* E. Meyer, *R. inflata* and *R. malacophylla* Boj. (Mauritius), *R. intermedia* Kotschy & Peyr. and others are referred to *R. Caribaea.* I have not been able to study most of these species very critically, but as regards *R. gibba,* judging from the large collection of that plant in the Herbarium of the British Museum and elsewhere, it seems very doubtful that it belongs to the American species.

The description of *R. Caribaea* DC. agrees well with Jacquin's plate, but the distribution of the species reads "*in ins. Caribaeis, ad ripam flum. Orinoci, ex* Kunth, Nov. Gen. Am. 6. '*125*' (425) et in Florida occidentali." This latter locality for the plant should refer to *R. reflexa* Nutt., then given as synonym, a species which is now rightfully reduced to *R. minima* (L.) DC., so that it is probable that the true *R. Caribaea* does not occur within the limits of the United States. Quite an extensive search in London and Paris for an authentic specimen of this species met with but scant success. In the Herbarium of the Museum of Paris there is a specimen which probably belongs to *R. Caribaea.* It has the following inscription: "*Rhynchosia Caribaea* Willd. Jacq. Ic. *t. 146.*" Pinned on the sheet after the fashion of the older herbaria is a small label with this note: "Phaseolus Madrepotanis pubescens, siliquis brevibus hirsutis horti nostri sesei [?] Ray. vol. 3, appendix.

Herbier de Vaillant." The writing on the label is supposed to be that of either Sherard or of Ray, and interlined and blurred so that a few of the words could only be guessed at. The "Herbier de Vaillant" contains many West Indian plants, among others specimens from the Antillian collection figured by Plumier,* and this specimen might have had some such provenance. In the Herbarium of the British Museum a specimen of Triana's collection in New Grenada also fairly well agrees with the Jacquin plate, as do also the specimens collected by Dr. Palmer, no. 269, from the State of Jalisco, Mexico, with, perhaps, the exception of the somewhat smaller leaves; but the latter specimens certainly are not *R. phaseoloides*, under which name they seem to have been distributed. Another plant, exactly matching Palmer's, was collected by Fred. Muller, no. 1768, in Mexico, in 1853. (Herb. Columbia Univ.) It has the very hirsute legume which is so marked a characteristic of the figure of *R. Caribaea.*

In Hemsley, Biologia Centr. Am. 1: 310, the distribution of *R. Caribaea* is given as South Mexico, near Tantoyuca (Ervenberg, no. 35) and "common in the West Indies and the northern part of South America; also in Tropical and South Africa." I have not seen the Ervenberg specimen, nor have I seen any South African specimens of *R. gibba*, which satisfied me as being identical with the plant figured by Jacquin. It proves a most interesting species, and it is to be hoped that these very incomplete notes will call the attention of collectors to it and possibly bring about a better knowledge of it and of its geographical distribution.

5. **Dolicholus Americanus** (Miller)

Lathyrus Americana Miller, Gardn. Dict. no. 19. 1768.

Rhynchosia menispermoidea DC. Mém. Leg. 364. 1823.

Phaseolus menispermoidea Eat. & Wright, N. Am. Bot. 353. 1840.

Texas to South Mexico.

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* Plumier's Herbarium of West Indian plants is preserved in the Herbarium of the Jardin des Plantes at Paris, where it is easily accessible to students. It consists of ten folio volumes, the specimens glued on the pages and numbered. They are in various stages of preservation and are especially valuable as being the originals of the figures in the Fasciculi Plantarum Americanum and of many Linnean types as well as the "Herb. Surian" of De Candolle's Prodromus.

Type in the Herbarium of the British Museum. For the record of the identification of this species see the article on Houston's Central American Leguminosae by James Britten and E. G. Baker in Journal of Botany for June, 1897.

6. **Dolicholus Michauxii**

Rhynchosia Michauxii Vail, Bull. Torr. Bot. Club, **22**: 458. 1895.

Rhynchosia menispermoidea Chapm. Fl. 105. 1860. Not DC.

Dry pine barrens, Florida.

Type in the Herbarium of Columbia University.

7. **Dolicholus cinereus** (Nash)

Rhynchosia cinerea Nash, Bull. Torr. Bot. Club, **22**: 149. 1895.

High pine lands, Lake County and Pelican Key, Florida.

Type in the Herbarium of Columbia University.

8. **Dolicholus tomentosus** (L.)

Glycine tomentosa L. Sp. Pl. 754. 1753.

Glycine tomentosa volubilis Michx. Fl. Bor. Am. **2**: 63. 1803.

Glycine tomentosa Pursh, Fl. Am. Sept. 486. 1814. Excluding var.

Arcyphyllum difformis Ell. Journ. Acad. Philad. **1**: 371. 1818.

Rhynchosia difformis DC. Prodr. **2**: 384. 1825. ?

Rhynchosia tomentosa H. & Pl. Comp. Bot. Mag. **1**: 23. 1835. Excluding the specimens.

Rhynchosia volubilis Wood, Bot. & Fl. 96. 1873. Not *R. volubilis* Loureiro, 1793.

The Linnean description of the species includes "*Ononis caule volubile*" Gronov. 81 and "*Anonis phaseoloides scandens, floribus flavis sessilibus*" Dill. Elth. 30 *t. 26. f. 29*, where the illustration is a good one of the plant as it is known on our eastern seaboard. The Clayton plants referred to are represented by two specimens in the Herbarium of the British Museum, one of *Glycine tomentosa*, the plant as figured by Dillenius, and one of the erect, oblong-leaved species described by Walter in 1788 as *Trifolium erectum*.

A specimen of the twining *Glycine tomentosa* is also in the Linnean Herbarium.

In dry soil, Virginia to Florida, Mississippi and probably also in Texas.

Dolicholus tomentosus undulatus n. var.

Perennial. Stems slender, twining, angled and striate, minutely and retrorsely hirsute: petioles 2–4 cm. long, angled, hirsute: stipules ovate, 3–4 mm. long, ciliate, persisting: leaves 3-foliolate; terminal petiolules 8 mm. to 5 cm. long; terminal leaflets oval or orbicular-oval, 2–4 cm. long, wide, obtuse or subacute, thinnish, minutely pubescent on both surfaces, with a few broad undulations on the margins; lateral leaflets inequilaterally ovate, 2–4 cm. long: racemes subsessile, 1–4- or 5-flowered: calyx 8–9 mm. long, pubescent, ciliate, resinous-dotted; lobes oblong, lanceolate, acuminate, foliaceous: corolla orange-yellow? nearly as long as the calyx or barely exceeding it when expanded; vexillum minutely puberulent near the apex and ciliate: legume 1.5–1.8 cm. long, oblong, obliquely acute, 5–7 mm. wide, minutely pubescent, resinous-dotted and hirsute with longer scattered hairs especially on the sutures, 2-seeded: seeds nearly 4 mm. long, semi-orbicular, shining, grayish with lighter and also dark brown markings.

Thickets and fields near Jacksonville, Florida, Chapman, 1846. (Herb. Mo. Bot. Gard.); N. Am. Pl. Curtiss, no. 660, July; Curtiss, no. 4256, July 6, 1893. (Distribution from the U. S, Nat. Herb.); Second Distr. Pl. Southern States, Curtiss, no. 4903.. July 6–17, 1894.

9. **Dolicholus Torreyi**

Rhynchosia Torreyi Vail, Bull. Torr. Bot. Club, **22**: 459. 1895.

Rhynchosia latifolia β Torr. & Gray, Fl. N. Am. **1**: 285. 1838. Not *R. latifolia* Nutt.

Sand hills, Texas, Dr. Leavenworth. Apparently not since collected.

Type in the Herbarium of Columbia University.

10. **Dolicholus Lewtoni**

Rhynchosia reticulata? Chapm. Fl. Ed. 3, 115. 1897. Not DC.

Soft pubescent and minutely resinous-dotted throughout. Stem prostrate, 3–5 dm. long or more, 4-angled, spreading or obscurely retrorse hirsute-pubescent, apparently not twining at the summit: stipules obliquely lanceolate, 6–8 mm. long: petioles rather distant, 4–6 cm. long, angled: terminal leaflets dilated or obovate-orbicular, 4–6 cm. long, 4–8 cm. wide, commonly broadest above the middle, broadly rounded and sometimes slightly retuse at the apex, narrowly subcordate at the base; lateral leaflets obliquely obovate-oblong; venation reticulated: upper racemes sessile, 2–4 cm. long, the other on peduncles 2–4 cm. long: bracts lanceolate, 3–4 mm. long, slender: calyx 9–10 mm. long; segments foliaceous, exceeding the glabrous yellow corolla. Legume not seen.

Dry sandy soil, Orange County, Florida, F. L. Lewton, July 7, 1894.

Allied to *D. Michauxii* Vail, from which it differs in the trifoliolate, abnormally large leaves, which are notably broadest above the middle and with narrow and less prominent subcordate bases. The calyx and corolla are also smaller than those of *D. Michauxii* and the racemes are longer.

Type in the Herbarium of Columbia University.

11. **Dolicholus latifolius** (Nutt.)

Rhynchosia latifolia Nutt.; Torr. & Gr. Fl. N. Am. **1**: 285. 1838.

Phaseolus latifolius Eat. & Wright, N. Am. Bot. 353. 1840.

In dry soil, Missouri to Texas and Louisiana.

Very variable. A low erect or sub-erect form with short or sub-sessile racemes has been collected in Texas by Lindheimer and in Missouri by B. F. Bush and may possibly be distinct.

12. **Dolicholus simplicifolius** (Walt.)

Trifolium simplicifolium Walt. Fl. Car. 184. 1788.

Glycine tomentosa var. *monophylla* Michx. Fl. Bor. Am. **2**: 63. 1803.

Glycine reniformis Pursh, Fl. Am. Sept. **2**: 486. 1814.

Glycine monophylla Nutt. Gen. **2**: 115. 1818.

Arcyphyllum simplicifolium Ell. Journ. Acad. Phila. **1**: 371. 1818.

Glycine simplicifolia Ell. Sk. **2**: 234. 1825. Not H. B. K.

Rhynchosia reniformis DC. Prodr. **2**: 384. 1825.

Rhynchosia tomentosa var. *monophylla* Torr. & Gray, **1**: 284. 1838.

Phaseolus reniformis Eat. & Wright, N. Am. Bot. 353. 1840.

Psoralea alnifolia Bert. Mem. Acad. Sci. Bolog. **2**: 274. 1849.

Rhynchosia simplicifolia Wood, Bot. & Fl. 96. 1873.

In dry soil, Virginia to Florida, west to Louisiana.

Type in the Herbarium of the British Museum.

13. **Dolicholus intermedius** (Torr. & Gr.)

Rhynchosia tomentosa β intermedia Torr. & Gray, Fl. N. Am. **1**: 285. 1838.

Psoralea alopecurina Bertol. Mem. Acad. Sci. Bolog. **2**: 275. *pl. 14. f. 2.* 1849.

Stems erect, simple or possibly with 1 or 2 branches, angled, soft pubescent-tomentose, especially on the angles, 1.2–3 dm. high; stipules obliquely lanceolate, 6–9 mm. long, striate, red-brown, persistent: petioles 2.5–5 cm. long, densely pubescent; basal leaves simple; blades nearly orbicular or rhombic-orbicular, obtuse or depressed; upper leaves or only the uppermost 3-foliolate; terminal leaflet 2.5–5 cm. long, oval to ovate-orbicular, obtuse, sparingly pubescent above, pubescent and rugosely veined beneath when old; lateral leaflets obliquely oval or oblong, 2–3 cm. long, mucronulate, some of them subcordate at base: racemes terminal and axillary, sessile or short-peduncled; bracts lanceolate-linear, 1 cm. long, red-brown, pubescent outside, glabrous within: calyx 8–9 mm. long; teeth slender, veined, pubescent, resinous-dotted: corolla yellow; vexillum glabrous, the teeth at the base much shorter than the claw: legume not seen.

Allied to *D. simplicifolius* from which it differs in the 3-foliolate upper leaves, and generally taller and larger habit.

Georgia to Florida and Alabama. May to June.

Type in the Herbarium of Columbia University.

14. **Dolicholus erectus** (Walt.)

Trifolium erectum Walt. Fl. Car. 184. 1788.

Glycine tomentosa var. *erecta* Michx. Fl. Bor. Am. **2**: 63. 1803.

Glycine erecta Nutt. Gen. **2**: 114. 1818. ?

Arcyphyllum erectum Ell. Journ. Acad. Phila. **1**: 372. 1818.

Rhynchosia erecta DC. Prodr. **2**: 384. 1825.

Glycine Caroliniana Spreng. Syst. **3**: 197. 1826.

In dry soil, Delaware to Florida, west to Tennessee and Louisiana. Very variable.

Type apparently lost.

An oblong-leaved, rather remarkable form of this species has been collected by Hall in Louisiana, in Salisbury, Maryland [Herb. Canby], and in Mississippi by W. L. McGee.

15. Dolicholus Drummondii

Rhynchosia tomentosa Hook. & Arn. Comp. Bot. Mag. **1**: 23. 1835. Not Linn.

Perennial, erect, densely velutinous-tomentose, 1.5–3 dm. high. Stems angled, a little undulate above: stipules lanceolate, acuminate, becoming reflexed, caducous; petioles 3–5 cm. long, angled and velutinous: leaves 3-foliolate; terminal leaflets oblong-lanceolate or a few of them oblong, 3–6 cm. long, 2–3 cm. wide, acute, densely velutinous tomentose on both surfaces, silvery above, the whole lower surface dotted with numerous orange-colored glands beneath the tomentum and the prominent veins reticulated beneath; lateral leaflets narrower, inequilateral, acute; racemes subsessile or very short peduncled: bracts 2.5 mm. long, linear-setaceous, caducous: calyx 6 mm. long, foliaceous, tomentulose and ciliate, resinous-dotted, the upper lobe 2-toothed to considerably below the middle: corolla included in the calyx, apparently a deep orange-yellow color; vexillum round-ovate, the auricles at the base rounded, minutely glandular-puberulent on the outer surfaces: legumes not seen.

Louisiana: Covington, Drummond, 1832; North Carolina: New Bern, Croom and Loomis, 1834.

Very close to *D. erectum* from which it differs in the acute leaflets, dense tomentum and somewhat smaller flowers.

Type specimens in the Herbarium of Columbia University.

16. Dolicholus mollissimus (Ell.)

Glycine mollissima Ell. Bot. **2**: 235. 1824.

Rhynchosia tomentosa var. ? *mollissima* Torr. & Gray, Fl. N. Am. **1**: 285. 1838.

Rhynchosia mollissima S. Wats. Biblio. Ind. **1**: 256. 1878.

Rhynchosia tomentosa var. *erecta* Chapm. Fl. 105. 1884. In part.

Stems erect, commonly simple, 3–6 dm. high, angled above, not flexuous, clothed with a close fine soft pubescence: stipules 6 mm. long, red-brown, lanceolate, acuminate; leaves rather remote, 5–9 cm. long; petioles 2.5–5 cm. long; leaflets oval or oval-oblong, acutish, 2.4–4.5 cm. long, 2–3.5 cm. wide, minutely apiculate, obscurely emarginate, clothed with a short pubescence, especially on the reticulated, resinous-dotted under surface; terminal leaflet the largest, the others not conspicuously inequilateral; racemes terminal, elongated, 6 cm.–1.8 dm. long, with often few, short racemes in the axils of the upper leaves: flowers scattered along the whole length of the often crowded rhachis: calyx 6–8 mm. long, pubescent, resinous-dotted, 4-parted about two-thirds to the base; teeth lanceolate: corolla yellow; vexillum glabrous, the spurs of the claw obtuse: legume oblong, 2 cm. long, 6 mm. wide, attenuated below, somewhat rounded on the ventral suture, with a short, acute, slightly curved acumination: seed nearly orbicular, 2.5 mm. broad, flattened: seeds ovoid, 4 mm. long, brown, mottled.

In pine barrens, Florida.

II. NOTE ON PAROSELA

The following species has been identified with *Parosela Arizonica:*

Parosela Lumholtzii (Rob. & Fern.)

Dalea Lumholtzii Rob. & Fern. Proc. Am. Acad. **30:** 115. 1894.
Parosela Arizonica Vail, Bull. Torr. Bot. Club, **24:** 14. 1897.

Vicinity of Tucson, Arizona; Las Pinitos, Sonora, Mexico.

COLUMBIA UNIVERSITY, March, 1899.

The Publications of the Department of Botany, C lumbia University, consist of Memoirs in quarto a Contributions in octavo.

The Memoirs already published are:—

Vol. I. **Small.** A monograph of the North American species the genus *Polygonum*. pp. 178. 84 plates. 1895. Pri six dollars.

Vol. II. **Rydberg.** A monograph of the North American Pot tilleæ. pp. 224. 112 plates. 1898. Price, six dollars

The Contributions have now reached the seventh volum

Vol. I. Nos. 1–25 (1886–1892). Out of print, except Nos. 6 11, 17, 20, 21, 22, 24. These can be supplied at twen five cents each, except No. 6, which is one dollar.

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 154

SOME NORTHWESTERN ERYSIPHACEAE

BY DAVID GRIFFITHS

NEW YORK

1899

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Some Northwestern Erysiphaceae

BY DAVID GRIFFITHS

The following list is prepared from material which has been accumulating since 1892. It is based upon specimens from South Dakota, Wyoming and Montana. The species recorded from the two latter States are in the nature of incidental gatherings which were made while engaged in other work during the summers of 1897 and 1898 in company with either Mr. L. W. Carter or Mr. T. A. Williams. Access has been had to the private herbarium and collections of Mr. Williams, and several hosts and one species are quoted from these collections. The list is by no means even approximately complete for the region covered. It is published simply as a preliminary list to which additions will doubtless be made when other localities are visited.

As might be expected from a knowledge of the altitudinal and climatic variations of the states mentioned, the species are exceedingly variable in both macroscopic and microscopic characters. These variations have been quite thoroughly worked out by Professor T. J. Burrill in Ellis & Everhart, N. A. Pyrenomycetes, but the variations here are in many cases still greater than recorded by either him or Dr. Rehm in Rabenhorst's Kryptogamen Flora. I find my material variable, especially in the extent of mycelial development and the usual microscopic measurements. In the matter of appendages, character of the wall of the perithecium and number of spores and asci I find less variation from published descriptions.

As to the identity of the species recorded here, there are two points regarding which there is some doubt. *Erysiphe cichoracearum* growing on *Bigelovia*, *Lygodesmia* and *Grindelia* appears to me to have some constant characters of its own. This I find to be the case in various exsiccatae which I have examined as well as in my own collections. The characteristics which appear to be the most distinctive are the abundant development of mycelium which gives a different appearance from the forms on the other composites even to the naked eye; and the number of asci and the lighter colored appendages are also quite characteristic. *Microsphaera diffusa* and *M. Ravenelii* are quite difficult of separation, especially in the immature condition. After careful examination of well authenticated specimens named by the describers, or duplicate specimens of the type material, I have referred my specimens on *Lathyrus* to *M. Ravenelii* and the forms on *Vicia* to *M. diffusa.* Attention might be called in passing to the necessity of good descriptions of the conidial stage of the Erysiphaceae as well as of the perithecial one. Some of my material shows good characters in the early condition of development.

An interesting observation regarding the apparent sudden appearance of *E. communis* on several species of *Polygonum* is worth recording. As stated before, the collection of fungi was begun in South Dakota in 1892, but no specimens of *E. communis* were found on *Polygonum* until 1895, when I found a few immature specimens in the northern part of the state, and Mr. Williams reported it from Brookings the same year. The next year more of it was found, and in 1897 and 1898 it was abundant everywhere. The fungus without doubt occurred on species of *Polygonum* long before we happened to find it; but that it occurred in small quantity previous to 1896 there can be no doubt.

It is interesting to compare the vertical distribution of these species. This is governed mainly, no doubt, by the habits of the hosts; but as some of the host plants recorded here are found at a much higher altitude and others at a much lower, the question naturally arises as to the extent of altitudinal influence. The following upper limits will be instructive:

ERYSIPHE COMMUNIS on *Oenothera albicaulis*, 6500 ft.

ERYSIPHE CICHORACEARUM on *Mertensia Sibirica*, 8500 ft.

ERYSIPHE GRAMINIS on *Agropyron tenerum*, 8500 ft.

MICROSPHAERA VACCINII on *Vaccinium Myrtillus microphyllum*, 8500 ft.

SPHAEROTHECA CASTAGNEI on *Arnica cordifolia*, 9500 ft.

SPHAEROTHECA HUMULI on *Viola Canadensis*, 7500 ft.

The altitudes are all given for localities on Clear Creek in the Big Horn Mountains in the vicinity of Buffalo, Wyo., where quite a complete collection was made from the base of the mountains to the snow line, which here is located at about 10500 ft. *Sphaerotheca Castagnei* was found at the highest level on *Arnica cordifolia*. This host is very abundant here at lower altitudes, but this was the only locality in which it was found affected with this fungus.

Some attention has been paid to the distribution of the fungi on closely related hosts of the region. A study of the list will furnish the best general idea on this point. *E. cichoracearum* has been found, as usual, on a great number of hosts and in several instances widely separated ones. While its favorite habitat appears to be on the composites it is by no means confined to this group. When these facts are taken into consideration it is rather astonishing to find an entire absence of the fungus on hosts which are generically related. A striking illustration came under my observation at Sheridan, Wyo. In the corner of a garden three species of the genus *Artemisia—A. Ludoviciana, A. tridentata* and *A. longifolia* were growing in profusion. They were in such close proximity that their branches were actually intertwined. Being in partially cultivated ground the growth of each was much more luxuriant than usual. *A. Ludoviciana* was loaded with *E. cichoracearum*, but careful search failed to reveal any on the other two species. I am not aware that the fungus has ever been recorded on either of these two species. This is all the more astonishing when we consider the frequency with which *A. Ludoviciana* is affected. In the absence of direct experimental evidence no positive reason can be given for the absence of this fungus on the two species in question under such apparently favorable conditions. Although closely related there is, however, a great difference in the aromatic principle and the development of trichomes in the two species, which may account for the phenomenon at least in part. A parallel case was observed in two other species of the same genus at Buffalo, Wyo. *A. dracunculoides* and *A. Canadensis* were growing together. The former had an abundance of *E. cichoracearum* upon it while the latter was entirely free. A directly opposite effect even in widely separated hosts was observed at Missoula, Mont. Here *Crataegus* and *Alnus* were growing so that the branches overlapped. The former was badly affected with *Phyllactinia suffulta* and the latter with *Microsphaera alni*. A small quantity of *P. suffulta* was found on the *Alnus* also.

ERYSIPHE CICHORACEARUM DC.

On *Verbena stricta* Vent., Oakwood, S. D.
- *Artemisia Ludoviciana* Nutt., Missoula, Mont.; Aberdeen, S. D.; Sheridan, Wyo.; Ft. McKinney, Wyo.
- *Artemisia dracunculoides* Pursh, Pierre, S. D.; Billings, Mont.; Buffalo, Wyo.
- *Achillea millefolium* L., Sylvan Lake, S. D.
- *Boltonia asteroides* L'Her., Aberdeen, S. D.
- *Rudbeckia hirta* L., Sylvan Lake, S. D.
- *Ambrosia trifida* L., Pierre, S. D.
- *Ambrosia psilostachya* DC., Huron, S. D.; Billings, Mont.
- *Bigelovia graveolens albicaulis* Gray, Merino, Wyo.; Ft. McKinney, Wyo.
- *Solidago nana* Nutt., Inyan Kara Mt., Wyo.
- *Solidago Canadensis* L., Tacoma Park, S. D.
- *Helianthus rigidus* Desf., Aberdeen, S. D.
- *Helianthus annuus* L., Missoula, Mont.
- *Helianthus tuberosus* L., Redfield, S. D.
- *Helianthus giganteus* L., Big Horn, Wyo.
- *Helianthus Maximilianus* Schard., Aberdeen, S. D.
- *Hydrophyllum Virginicum* L., Big Stone Lake, S. D.
- *Aster laevis* L., Missoula, Mont.
- *Chrysopsis villosa* Nutt., Buffalo, Wyo.
- *Helenium montanum* Nutt., Missoula, Mont.
- *Mertensia Sibirica* Don., Buffalo, Wyo.
- *Phacelia circinata* Jacq., Missoula, Mont.
- *Galium triflorum* Michx., Missoula, Mont.
- *Carduus altissimus* L., Ft. McKinney, Wyo.
- *Grindelia squarrosa* Donal, "L. A. K." Ranch, S. D.; Aberdeen, S. D.; Ft. McKinney, Wyo.
- *Balsamorrhiza sagittata* Nutt., Buffalo, Wyo.
- *Macrocalyx nyctalea* (L.) Kuntze, Big Stone Lake, S. D.
- *Lygodesmia juncea* Don., Buffalo, Wyo.
- *Erigeron macranthus* Nutt., Bear Lodge Mts., Wyo.

ERYSIPHE COMMUNIS (Wallr.) Fr.

On *Polygonum ramosissimum prolificum* Small, Rapid City, S. D.
- *Polygonum ramosissimum* Michx., Rapid City, S. D.; Pierre, S. D.; Billings, Mont.

Polygonum littorale Link., Grindstone Buttes, S. D.
Polygonum aviculare L., Buffalo, Wyo.; Rapid City, S. D.
Lupinus sericeus Pursh, Inyan Kara Mt., Wyo.
Thalictrum purpurascens L., Tacoma Park, S. D.
Spiesia Lamberti (Pursh) Kuntze, Grindstone Buttes, S. D.; Buffalo, Wyo.
Ranunculus Pennsylvanica L., Little Mo. Buttes, Wyo.
Homalobus cespitosus Nutt., Inyan Kara Mt., Wyo.
Lotus Purshiana (Nutt.) Bisch., Belle Foursche, S. D.
Oenothera albicaulis Nutt., Buffalo, Wyo.
Trifolium varigatum Nutt., Lo Lo, Mont.
Psoralea tenuiflora Pursh, Billings, Mont.
Astragulus oroboides Americanus Gray, Buffalo, Wyo.
Astragulus frigidus Americanus (Hook.) Watson, Buffalo, Wyo.
Astragalus Canadensis L., Tacoma Park, S. D.
Lespedeza striata Hook. & Arn., Brookings, S. D.

ERYSIPHE GALEOPSIDIS DC.

On *Stachys palustris* L., Missoula, Mont.; Aberdeen, S. D.; Ft. McKinney, Wyo.; Huron, S. D.

ERYSIPHE GRAMINIS DC.

Poa nemoralis L., Bear Lodge Mts., Wyo.; Hot Springs, S. D. Lake Hendricks, S. D.
Poa serotina Ehr., Missoula, Mont.
Poa pratensis L., Ft. McKinney, Wyo.; Brookings, S. D.
Bromus unioloides Willd., Brookings, S. D.
Bromus breviaristatus (Hook.) Buckl., Buffalo, Wyo.; Missoula, Mont.
Agropyron tenerum Vasey, Buffalo, Wyo.
Beckmannia erucaeformis Hort., Belle Foursche, S. D.

SPHAEROTHECA CASTAGNEI Lev.

On *Lepargyraea argentea* (Nutt.) Greene, Sheridan, Wyo.; Devil's Tower, Wyo.
Lepargyraea Canadensis (L.) Greene, S. Fork Piney River, Wyo.
Troximon officinalis Weber, Billings, Mont.
Crepis runcinata T. & G., Buffalo, Wyo.
Arnica cordifolia Hook., Buffalo, Wyo.

Gillardia aristata Pursh, Missoula, Mont.
Troximon glaucum Pursh, Buffalo, Wyo.; Red Lodge, Mont.
Pedicularis Groenlandica Retz., Buffalo, Wyo.
Fragaria glauca (Watson) Rydb., Missoula, Mont.
Collomia linearis Nutt., S. Fork Piney River, Wyo.
Senecio triangularis Hook., Red Lodge, Mont.
Lophanthus anisatus Benth., Little, Mo.; Buttes, Wyo.
Bidens frondosa L., Scatterwood, S. D.

SPHAEROTHECA HUMULI (DC.) Burrill

On *Viola Canadensis* L., Buffalo, Wyo.
Geranium Richardsoni Fisch., Bear Lodge Mts., Wyo.
Humulus Lupulus L., Buffalo, Wyo.

SPHAEROTHECA EPILOBII (Link.) DeB.

On *Epilobium adenocaulon* Hausskn., Sylvan Lake, S. D.; Buffalo, Wyo.

SPHAEROTHECA MORS-UVAE (Schw.) B. & C.

On *Ribes lacustre* Prior., Buffalo, Wyo.
Ribes Hudsonianum Richards, Missoula, Mont.
Ribes floridum L'Her., Rondell, S. D.

SPHAEROTHECA PANNOSA (Wallr.) Fr.

On *Rosa Woodsii* Lindl., Ft. McKinney, Wyo.

PODOSPHAERA OXYACANTHAE (DC.) DeB.

On *Spiraea lucida* Dougl., S. Fork Piney River, Wyo.
Prunus Americana Marshall, Redfield, S. D.
Prunus Virginiana L., Bigstone Lake, S. D.
Prunus demissa Walp., S. Fork Piney River, Wyo.
Prunus pumila L., Brookings, S. D.
Crataegus rivularis Nutt., Little, Mo.; Buttes, Wyo.

PHYLLACTINIA SUFFULTA (Reb.) Sacc.

On *Philadelphus Lewisii* Pursh, Missoula, Mont.
Betula occidentalis Hook., Ft. McKinney, Wyo.
Crataegus rivularis Nutt., Missoula, Mont.
Cornus stolonifera Michx., Missoula, Mont.; Big Stone Lake S. D.

Alnus incana virescens Watson, Missoula, Mont.
Negundo aceroides Moench., Brookings, S. D.
Fraxinus viridis Michx., Brookings, S. D.
Celastrus scandens L., Brookings, S. D.

MICROSPHAERA SYMPHORICARPI E. C. Howe

On *Symphoricarpos occidentalis* Hook., Tacoma Park, S. D.
Symphoricarpos racemosus Michx., Missoula, Mont.

MICROSPHAERA VACCINII C. & P.

On *Vaccinium Myrtillus microphyllum* Hook., Buffalo, Wyo.

MICROSPHAERA ALNI (DC.) Wint.

On *Syringa vulgaris* L., Brookings, S. D.
Euonymus atropurpureus Jacq., Brookings, S. D.
Alnus incana virescens Watson, Missoula, Mont.
Lonicera glaucescens Rydb., Bear Lodge Mts., Wyo.

MICROSPHAERA QUERCINA (Schw.) Burrill

On *Quercus macrocarpa* Michx., Little, Mo.; Buttes, Wyo.

MICROSPHAERA DIFFUSA C. & P.

On *Vicia Americana truncata* (Nutt.) Brewer, Snoma, S. D.
Vicia linearis (Nutt.) Greene, Brookings, S. D.
Vicia Americana Muhl., Buffalo, Wyo.
Glycyrrhiza lepidota Pursh, Little Mo. Buttes, Wyo.

MICROSPHAERA RAVENELII Berk.

On *Lathyrus vinosus* Muhl., Sylvan Lake, S. D; Bear Lodge Mts., Wyo.

UNCINULA SALICIS (DC.) Wint.

On *Salix cordata* Muhl , Aberdeen, S. D.
Salix sp., Little Mo. Buttes, Wyo.
Populus tremuloides Michx., Sylvan Lake, S. D.; Red Lodge, Mont.
Populus balsamifera L., Buffalo, Wyo.

UNCINULA MACROSPORA Peck.

On *Ulmus Americana* L., Brookings, S. D.

UNCINULA NECATOR (Schw.) Burrill.

On *Parthenocissus quinquefolia* (L.) Planch, Brookings, S. D.
COLUMBIA UNIVERSITY, March 1, 1899.

The Publications of the Department of Botany, Columbia University, consist of Memoirs in quarto and Contributions in octavo.

The Memoirs already published are:—

Vol. I. **Small.** A monograph of the North American species of the genus *Polygonum*. pp. 178. 84 plates. 1895. Price, six dollars.

Vol. II. **Rydberg.** A monograph of the North American Potentilleæ. pp. 224. 112 plates. 1898. Price, six dollars.

The Contributions have now reached the seventh volume.

Vol. I. Nos. 1–25 (1886–1892). Out of print, except Nos. 6, 7 11, 17, 20, 21, 22, 24. These can be supplied at twenty-five cents each, except No. 6, which is one dollar.

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Vol. VI. Nos. 126–150 (1897–1898). Five dollars; single numbers, twenty-five cents, except Nos. 129 and 143, fifty cents,

Vol. VII. No. 151—(current).

Lists of titles of Contributions may be had on application

LUCIEN M. UNDERWOOD,
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NEW YORK CITY.

CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 155

HE COMMON PARASITE OF THE POWDERY MILDEWS

BY DAVID GRIFFITHS

NEW YORK
1899

eprinted from the BULLETIN OF THE TORREY BOTANICAL CLUB. **26** : *184–188*. 12 Apr., 1899.]

[Reprinted from the BULLETIN OF THE TORREY BOTANICAL CLUB, 26 : Apr. 1899.]

The common Parasite of the Powdery Mildews

BY DAVID GRIFFITHS

(PLATE 358)

AMPELOMYCES QUISQUALIS Ces. Bot. Zeitung **10** : 301. 1852.

Cicinobolus florentinus Ehr. Bot. Zeitung **11** : 16. 1853.

Bassocystis textilis Riess. Bot. Zeitung **11** : 236. 1853.

Cicinobolus cesatii DeBary, Morph. und Phys. der Pilze, **3** : 53–75. *pl. 6, 7.*

Cicinobolus oidii Tuck. Rabenhorst, Fungi Europaei, No. 2215.

Cicinobolus humuli Faut. Revue Mycol. **12** : 37. 1890.

Cicinobolus cotoneus Pass. Thuemen Mycotheca Universalis, **17** : No. 1668.

Cicinobolus uncinulae Faut. Roumeguere Fungi Selecti Galliae **43** : No. 6208.

Cicinobolus major Kell & Swingle, Herb. J. B. Ellis, **37** : No. 84.

This plant attracted my attention a number of years ago on account of its abundance; a subsequent study of it in the field and laboratory has revealed some interesting facts. Its abundance on the forms of *Erysiphe cichoracearum* growing on *Grindelia squarrosa* in the Northwest is very noticeable. My first collection of it at Aberdeen, South Dakota, was made in 1893, but on account of the entire absence of fruit in the host (*Erysiphe*), I was unable to make any specific determinations. Although a careful search for fruiting specimens was made in the same locality for the next five years none were found. The conidial stage occurred in abundance and it was almost invariably accompanied by the *Ampelomyces.* While in company with Mr. L. W. Carter in western South Dakota and northeastern Wyoming in 1897, I collected fine fruiting specimens of the *Erysiphe* at the "L. A. K." ranch in South Dakota and at Moorcroft, Wyoming. The former was unaffected by the fungus, while the latter had practically no perithecia in a healthy condition. The latter was as fine an illustration of parasitism as one could wish to see. There was at least one-half acre of the *Grindelia* on a small creek bottom growing as thick as it could well stand, and it would have been difficult to find any leaves in the whole patch that were unaffected with the *Erysiphe*; but none of it was able to produce mature perithecia on account of the depredations of its parasite. It would be interesting to know whether the conidial stage of the *Erysiphe* carries the plant over the winter season or whether the *Grindelia* becomes inoculated by the same species growing on other composites in the same locality. It is also interesting to compare this case with the propagation of the conidial stage of the grape mildew in European countries year after year without the intervention of the perithecial stage.

While in company with Mr. T. A. Williams in Wyoming and Montana in 1898, an abundance of this plant was found on *Grindelia squarrosa* and *Lygodesmia juncea*, especially in the vicinity of Buffalo, Wyoming, and Billings, Montana. The specimens collected at old Fort McKinney in Wyoming show the habits of the parasite the best of any which I have. The *Erysiphe* on the lower leaves is practically destroyed but that on the upper younger leaves produces perithecia in abundance. The *Ampelomyces* is easily recognized by its dusty appearance which gradually grades off into the characteristic white appearance of the mycelium of the host. In this intermediate region the pycnidia may be found in abundance which develop within the perithecia, and which consequently have a globular appearance. On the lower leaves the pycnidia are usually of the oval or pyriform type. This is easily accounted for from the fact that the *Ampelomyces* produced its pycnidia on the lower leaves at a time when there were no perithecia formed and did not spread as rapidly as the host. The same holds true in general of specimens collected near Buffalo, Wyoming, on *Lygodesmia juncea*, excepting that the areas affected by *Ampelomyces* are more localized and scattered.

Besides the synonymy given above two other species of this genus have been described, *i. e.*, *Cicinobolus plantaginis* Oud. and *C. parasiticus* (Cocc.) Sacc., specimens of which have not been seen and concerning which, consequently, no positive statements can be made. So far as the descriptions in Sylloge Fungorum are concerned, however, there is nothing to prevent both of these species being placed here.

Having included some characteristics of this species which, so far I am aware, have not been noted before, it may not be out of place to include the following description based on specimens from both Europe and America.

Mycelium variable, hyaline to fuscous, within the mycelium of species of Erysiphaceae and occasionally in the tissues of the host plant (Fig. 16), 4 to 8 (usually 4 to 5) μ in diameter; pycnidia very variable in size and form, membranous, oval, pyriform to globular, fuscous to brown, produced in horizontal mycelium (Fig. 8), conidophore (Fig. 1–7), or perithecium (Fig. 10–12); spores hyaline, oblong, often slightly inequilateral, biguttulate when mature, 6½–10½ × 3½–6 μ (Fig. 15).

There occurs in the various descriptions of this species, under different names, a wide variation in characteristics which in many groups would establish good species, and indeed might here were it not for the extreme variability of single specimens. In some cases the pycnidia have been described oval to pyriform and stipitate, and in other cases globular. The accompanying figures will clear away all doubt regarding the possibility of such a variation and explain how it occurs. In my specimens on *Grindelia* a variation of fifty μ in size of the perithecia may often be found in the same microscopic field. A great discrepancy also occurs in the measurement of spores by various observers; when, however, the specimens from which these measurements were made are compared with one micrometer scale they are reduced to the limits easily attained in any species. Descriptions vary also in the matter of guttulation of the spores, some being described as guttulate and others as continuous. My specimens on *Grindelia* and *Lygodesmia* show both of these conditions in different stages of development. When mature the spores always show the characteristic guttulae. One may, by squeezing young pycnidia under the cover slip, see small, oval, globular or irregular continuous cells. A study of De Bary's figures of the spore development will easily show that these are nothing more than the young spores imperfectly formed, or in some cases simply cells of the pycnidia. In examining some of the herbarium material at hand, especially European exsiccati, this phenomenon was often met with. Careful examination of my own material collected early in the season showed the same peculiarity; and in some exsiccati, notably *Cicinobolus cotoneus* Pass., both mature and immature pycnidia were common.

HOSTS EXAMINED

Oidium cydoniae Pass. parasitic on *Cydoniae vulgaris* Pers.

Oidium erysiphoides Fr. (*Sphaerotheca humuli* (DC.) Burrill ?) parasitic on *Humulus* sp.

Oidium Tuckeri Berk. (*Uncinula necator* (Schw.) Burrill ?) parasitic on *Vitis vinifera* L.

Sphaerotheca phytoptophila K. & S. parasitic on *Celtis occidentalis* L.

Sphaerotheca Castagnei Lev. parasitic on *Bidens cernua* L.

Conidial stage of Erysiphaceae, parasitic on *Cynoglossum* sp.

Erysiphe communis (Walk.) Fr. parasitic on *Pisum sativum* L.

Erysiphe cichoracearum DC. parasitic on *Grindelia squarrosa* Dounal and *Lygodesmia juncea* Don.

Sphaerotheca Castagnei Lev. parasitic on *Collomia linearis* Nutt. and *Epilobium adenocaulon* Haus.

Phyllactinia suffulta (Reb.) Sacc. parasitic on *Crataegus rivularis* Nutt.

Microphaera alni (DC.) Wint. parasitic on *Lonicera glaucescens* Rydb.

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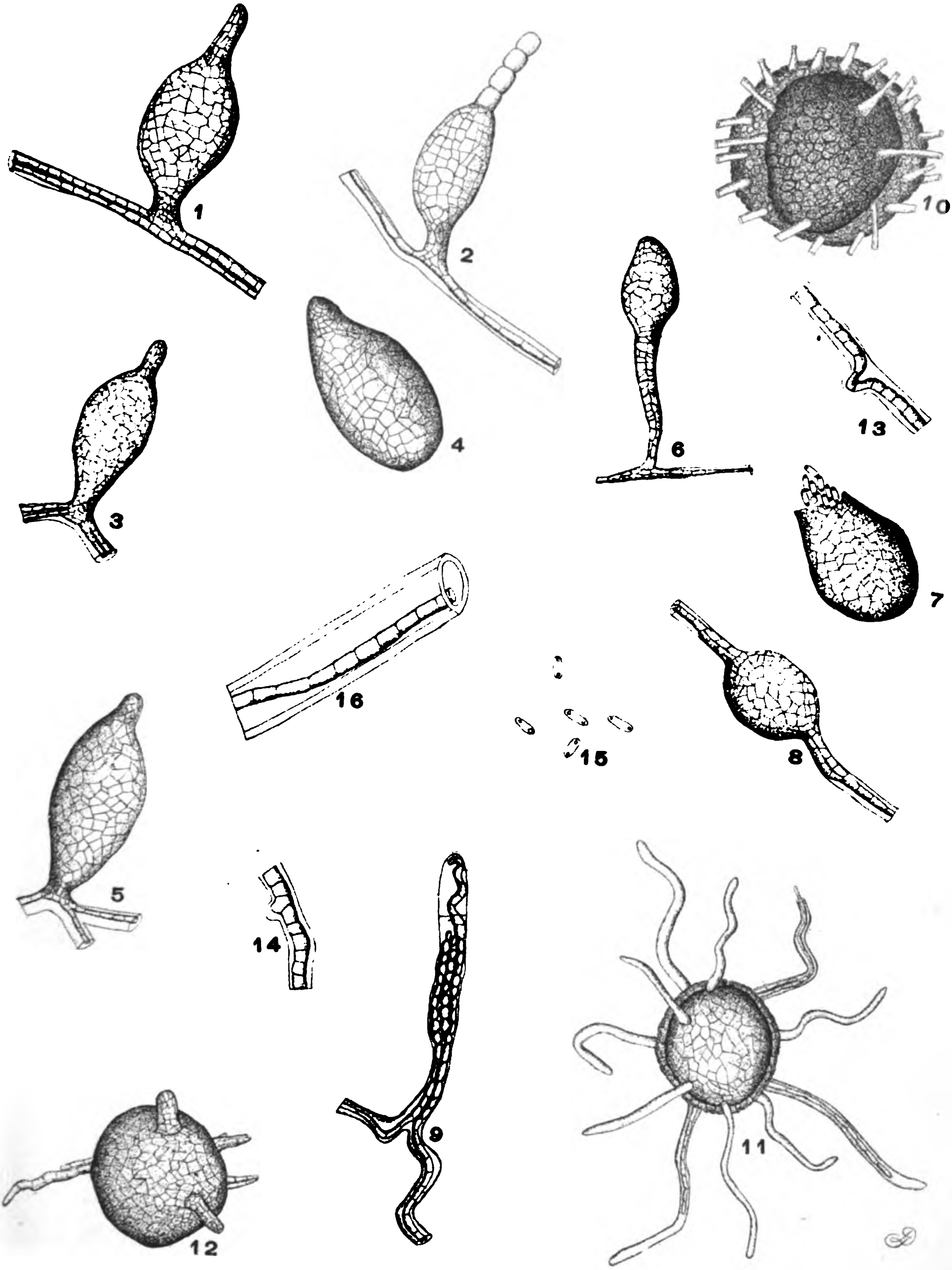
Bot. Zeitung. **10**: 301, 1852; **11**: 16, 236, 1853. DeBary, A. Morphologie und Biologie der Pilze, **3**: 53–75, *pl. 6, 7*. De Bary, A. Morphology and Biology of the Fungi, Mycetozoa and Bacteria, 247, *f. 119*. Saccardo, P. A. Syll. Fung. **3**: 216, **10**: 220, **11**: 502. Flora, **35**: 397. 1852. Schenk, Handbuch der Botanik **4**: 324–327, 544. 1890. Ellis and Everhart, North American Pyrenomycetes 3, 4, 1892. Leunis and Frank, Synopsis der Pflanzenkunde, **3**: 353, *f. 94*. 1886. Tulasne, Selecti Fung. Carp. **1**. Oestr. Wochenb. **14**: 126–128, 1888. Revue Mycol. **12**: 73, 176, 1890; **15**: 16, 69, 1893. Hedwigia, **1**: 23, 1852.

EXSICCATI EXAMINED

Roumeguere, Fungi Selecti Galliae, nos. 6107, 6108, 5461, 6207, 6208. Sydow. Mycotheca Marchica, no. 1537. Rabenhorst, Fungi Europae, no. 2215. Krieger, Fungi Saxon, no. 987. Thuemen. Mycotheca Universalis, no. 1668.

,87-



AMPELOMYCES QUISQUALIS Ces.

THE HELIOTYPE PRINTING CO., BOSTON

Explanation of Plate 358

1. Pycnidium produced in conidiophore on *Grindelia.* All remains of the conidiophore have disappeared, but the mycelium of *Ampelomyces* can be seen within the mycelium of the *Erysiphe.*

2. The same with the remains of the conidiophore.

3. Pycnidium of *C. cotoneus* Pass. (Thuemen, Mycotheca Universalis, no. 1668).

4. Pycnidium on *Grindelia.*

5. Pycnidium of *C. humulis* Faut. from duplicate of the original material (Roumeguere, Fungi Sel. Gal. no. 5461).

6. Pycnidium evidently developed in the upper part of a conidiophore on *Lygodesmia juncea.*

7. Pycnidium of *C. uncinulae* Faut. from duplicate of the original material (Roumeguere, Fungi Sel. Gal. no. 6208).

8 Pycnidium developed within the horizontal mycelium threads on *Grindelia.*

9. Young pycnidium on *Lygodesmia juncea.*

10. Young pycnidium developing within a large perithecium on *Grindelia.*

11. Pycnidium within a smaller perithecium. The wall of the perithecium has almost disappeared. Some of the appendages contain the mycelial threads of the fungus.

12. Pycnidium developed within the perithecium, the perithecium having entirely disappeared. The appendages will be easily recognized as a development of the mycelium within the appendages as seen in 11.

13 and 14. Mycelium of *Ampelomyces* within the mycelium of *Erysiphe cichoracearum* on *Lygodesmia juncea*, the mycelium of the former growing into the haustoria of the latter.

15. Spores from specimen on *Grindelia.*

16. Mycelium of *Ampelomyces* within the leaf hairs of *Cydonia vulgaris* Thuemen's Myc. Univ. no. 1668).

NOTE.—All drawings magnified 270 diameters except no. 10, which is magnified 190 diameters.

COLUMBIA UNIVERSITY, 1 March, 1899.

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 156

AMERICAN FERNS—II. THE GENUS PHANEROPHLEBIA

BY LUCIEN MARCUS UNDERWOOD

NEW YORK
1899

[Reprinted from the BULLETIN OF THE TORREY BOTANICAL CLUB, **26** : *205–216.* 15 May, 1899.]

American Ferns—II. The Genus Phanerophlebia

By Lucien Marcus Underwood

(Plates 359, 360)

During the past generation it has been customary for English and American botanists to refer to a single species, *Aspidium juglandifolium*, a long series of widely different ferns from Mexico, Central America and Vénezuela. The original *Polypodium juglandifolium* was described from Caripe, Venezuela, by Humboldt, and his type is in the Willdenow herbarium. The relation of our own flora to this species commenced with the discovery of a plant on the Mexican Boundary Survey * which was referred to this species although it specifically resembles the type almost as little as it does *Polystichum acrostichoides* or any one of a half dozen species.

Several species have been separated from time to time by Schlectendal, by Martens and Galeotti, and later by Fournier. The latter in his list of the Ferns of Mexico † distinguishes five species but his knowledge of the typical form appears to have been somewhat at fault. Later still, Mr. Hemsley ‡ following Mr. Baker, unites all these divergent plants under a single species and the forty-three specimens at Kew are included under a single cover.

---

*.Under the head of *Aspidium juglandifolium* in Eaton's Ferns of North America, we have the curious anomaly of a description of one species, a figure drawn from a second, details of venation from a third, and the name of a fourth given to the aggregation.

† Mexicanas Plantas, 1 : 100. 1872.

‡ Biologia Centrali-Americana, 3 : 642. 1885.

[Issued 15 May, 1899.]

The genus *Phanerophlebia* (Presl, Tent. Pteridogr. 84. 1836) was established by Presl together with the genus *Amblia* (Presl, Tent. Pteridogr. 184. 1836) the former founded on *P. nobilis** and the latter on *P. juglandifolia*, the genera differing only in the supposed absence of indusia in the latter genus. It represents a somewhat natural group of plants of the Aspidieae with once pinnate leaves, coriaceous or herbaceous habit and 3–4-forked veins which in some species unite more or less copiously in the outer portions of the pinnae and in others remain free. In the species with normally free veins, however, accidental areolae sometimes appear. John Smith (in his later writings) and Moore united this genus with *Cyrtomium* whose type is the common *C. falcatum* of cultivation, but in that species and its allies a widely different type of venation occurs which in our judgment is sufficient for generic distinction. The relations of this genus to other generic groups which have been united under *Aspidium*, *Nephrodium*, and other names will be discussed later in this series of papers.

The genus *Phanerophlebia* has a limited distribution, ranging from the northern coast of South America to Arizona and New Mexico. There are at least eight species which may be easily separated as follows:

- Veins regularly and copiously anastomosing.
  - Pinnae 5–11, 4–5 cm. wide; inner line of sori near the midrib. 1. *P. juglandifolia.*
  - Pinnae 16–20, 2–3 cm. or less wide; inner line of sori 3–5 mm. from the midrib. 3. *P. remotispora.*
- Veins free or exceptionally anastomosing at rare intervals.
  - Pinnae 3–5, cordate at base. 2. *P. pumila.*
  - Pinnae 10–30, acute or obliquely obtuse at base.
    - Pinnae 7–15 cm. long, normally set at an angle of 50–75° with rachis.
      - Pinnae mostly auricled on the upper side of the base. 6. *P. auriculata.*
      - Pinnae obtuse or acute at base, not auricled.
        - Inner line of sori near the midrib; rachises smooth. 4. *P. nobilis.*
        - Inner line of sori 4 mm. from midrib; rachises scaly. 5. *P. umbonata.*

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* While this genus is nominally founded on *P. nobilis*, the description and figure of the venation show a plant with anastomosing veins and it is more than probable that *P. remotispora*, a species not separated until over thirty years later, was the plant Presl had in hand. This point, which does not affect the establishment and validity of the genus, can probably be settled by an examination of Presl's plant at Prag.

Pinnae 18–20 cm. or more long; normally set at an angle of 30–40° with the rachis.
  Sori in a single row with two others incomplete, 2.5 mm. in diameter.
    7. *P. macrosora.*
  Sori usually in four or less complete rows, small, 1.2 mm. wide.
    8. *P. Guatemalensis.*

1. PHANEROPHLEBIA JUGLANDIFOLIA (H. & B.) J. Sm. Hook. Jour. Bot. **4**: 187. 1842.

Polypodium juglandifolium Humb. & Bonp.; Willd. Sp. Pl. **5**: 195. 1810.

Aspidium juglandifolium Kunze, Linnaea **20**: 363. 1847.

Cyrtomium juglandifolium Moore, Index Filicum, lxxxiii. 1857.

Amblya juglandifolia Presl. Tent. Pterid. 185. *pl. 7. f. 3.* 1836.

Rootstock short, ascending, with few scales: stipes slender, rarely with a few straggling scales, stramineous, 30–40 cm. long: pinnae 5–11 (mostly 7–9), 3–5 cm. apart, often with a tuft of tomentose scales in the axils, the terminal largest, 20×5 cm., the lowest smallest, 12×4.5 cm., often falcate; base obtuse; apex acute and often strongly acuminate; margin undulate below, becoming more and more distinctly serrulate toward the apex; texture subcoriaceous with a cartilaginous margin which extends into short rigid teeth, 0.5 mm. long; veins anastomosing throughout, the first row of areolae elongate, 1.5 cm., mostly with a free included veinlet which bears the first sorus about a millimeter from the base, the outer areolae smaller: sori 1.5 mm. across, the inner series 2 mm. from the midrib, the second series 5–7 mm. further out, a partial third series 2 mm. still farther removed from the midrib.

The type of this species is in Willdenow's collection at Berlin and is marked 434 Caripe,* Humboldt. This is almost exactly matched by a considerable number of specimens in various collections as follows:†

---

* Caripe, not always shown on the maps, is near the north coast of Venezuela, 28 kilometers S. S. E. from Cumana.

† In the citation of specimens it is desirable to indicate in what collections specimens have been examined, both to convey information as to where specimens of any given species can be consulted and because of variations existing under the same number of certain collectors. In this paper the herbaria are designated as follows:—B, Berlin;—C, Columbia;—D, Davenport (Massachusetts Horticultural Society);—E, D. C. Eaton, New Haven;—G, Gray, Cambridge;—K, Kew;—N, United States National Museum, Washington;—P, Philadelphia Academy of Sciences;—U, the writer's own collection.

VENEZUELA: Humboldt, 434 (B); Miguel, 20 (K); Buschel, (K, E); Funcke, 211 (K); Otto, 644 (K); Linden, 164 (K); Fendler, 233, in part (E, P).

[COLUMBIA: Andes Bogotenses, Triana.]

GUATEMALA: Salvin & Godman, 113 (G, K); J. Donnell Smith, 1051 (K); 768 (K, G, C, P).

MEXICO—*Chiapas:* Ghiesbreght, 414 (K, G, E).

The typical form of this species from Venezuela is well named *juglandifolium*, as the resemblance to walnut leaves is very striking. The Guatemalan specimens of Salvin and Godman are provided with slightly larger pinnae (terminal 20 × 6 cm., lower lateral 20 × 5 cm. scarcely falcate) and with more pronounced bristle teeth; the Mexican specimens have smaller pinnae, 12 × 2.5–3 cm., and also more pronounced bristle teeth. All agree in the basal and apical characters of the pinnae, venation, position of sori, the number of pinnae and the general habit.

Much is still to be desired regarding the rootstock. The Venezuelan specimens collected by Fendler and distributed under no. 233 are quite different from each other. That of Eaton's collection and the one in Short's herbarium at the Philadelphia Academy are nearly normal, but those of the Kew and Gray herbaria are younger, show more scaly rootstock, longer stipes with quite large dark-brown scales, and with a larger number of sori, the outer rows being more irregular, particularly in the specimen in Herb. Gray. A second species is clearly involved under this number.

The species is, however, very sharply circumscribed, its geographical limits are clearly marked, and it is not to be confused with the very distinct species found farther north.

2. PHANEROPHLEBIA PUMILA (Mart. & Galeotti) Fée, Gen. Filicum, 282. 1852.

Aspidium pumilum Martens & Galeotti, Mém. sur les Fougères du Mexique, 64. *pl. 17. f. 1.* 1844.

Aspidium juglandifolium D. C. Eaton, Ferns of North America, 2: *pl. 75. f. 5–8.*

Rootstock so far as known short and compact: stipes clustered, 5–11 cm. long, stramineous or brownish, densely scaly with narrow slender lanceolate scales: pinnae 1–5 (in one rare case 10), the terminal much the largest, 6–10 cm. long, 2.5–2.8 cm. wide, the lateral 3–3.5 cm. long, 2–2.5 wide, all cordate at the base, the terminal normally acute, the lateral mostly obtuse except for the terminal spine; margins with projecting spines 1 mm. long: sori in two usually complete rows with occasionally scattering outliers, the inner row 1–3 mm. from midrib, the second row 2–3 mm. farther out: veins free, 2–4 times forked, the sori borne mostly on the middle of the alternating branches.

MEXICO [*Oaxaca:* Galeotti, 6251]. *Chiapas:* Ghiesbreght (K, G, E, U); Linden, 1552 (K).

There appears to be considerable variation in the number of pinnae though the predominating number is 3 as seen by the following series examined:

Ghiesbreght (Hb. Eaton) 1, 2, 3, 3, 3, 3, 3, 3, 4; (Hb. Gray) 3, 5, 5, 10 *; (Hb. Underwood) 2, 4; (Nat. Herb.) 5; (Hb. Kew) 3, 3, 3, 5, 5, 5, 5; Linden (Hb. Kew) 3, 3, 3, 3.

The relation of this species to *P. Lindeni* is not clear. Of the latter I have seen only the Kew specimen (Chiapas, Linden, 1551) which is represented by two leaves with the following measurements: terminal pinnae 14 × 3 cm., lateral 9 × 2.3 cm., the terminal remote (2.5–3 cm.) from the lateral, all the pinnae taper-pointed.† In one of the leaves there is an auriculate base on each lateral pinna. In Eaton's specimen of *P. pumila* there is a single leaf strikingly similar to Linden, 1551, but smaller and totally unlike any of the other specimens of the sheet. This leaf is disconnected from the other specimens, so may belong to a different plant from the rooted specimen; its dimensions are: stipe 17 cm., terminal 10 × 2.3 cm., lateral 6.5 × 1.7 cm. While there is no question that we have in *P. pumila* a species totally distinct from any other of the group, only field work will determine whether we do not also have two. In other words *P. Lindeni* may be a distinct species.

3. PHANEROPHLEBIA REMOTISPORA Fourn. Mex. Plantas **1**: 100. 1872.

Rootstock unknown: stipes 35–40 cm. long, stramineous, with broad brownish scales on the lower fourth, naked above: leaf 35–40 cm. long, with 16–20 pinnae which are 10 cm. or more long, 1.5–2.8 cm. wide, unequally obtuse or slightly acute at base, the apex tapering, slightly falcate; margin prickly, the spines more or less appressed near the base, more spreading at the apex; terminal pinnae slightly larger: veins anastomosing, the first branch from each vein bearing a sorus above its middle, either ending as a free included veinlet or rarely uniting with some other vein: sori small, 1 mm. or less in diameter, in two or three rows, the innermost row 3–5 mm. from the midrib.

---

* This leaf, which is separate from the other three which constitute the specimen, is also peculiar in showing broadly obtuse almost truncate bases to the lateral pinnae and an acute apex and with a falcate upper curve.

† It should be noticed that the pinnæ of Linden's 1552 are more acute than in hiesbreght's specimens.

The type of this plant was collected in Orizaba by Bourgeau, 2349, and appears to extend from southeastern Mexico to Guatemala.

MEXICO—*Vera Cruz:* Orizaba, Bourgeau, 2349 (K, N, G, C, E), 2348 (C); Mohr, 87 (E); Müller, 729 (C); Witmer, 99 (P). Xalapa, Coulter, 1712 (K). Cordoba, Schaffner, 23 (K); Kerber, 69 (K). Mirador, Liebmann (K, G).

GUATEMALA: J. D. Smith, 3259 (K, N, C).

The Guatemala specimens have narrower pinnae and fewer of slightly larger sori. Specimens are also in the Kew Herbarium from Mexico collected by Graham, 404, and from Zhuitlancella, 2349. In the Gray collection is a single plant collected in Xalapa by Charles L. Smith, mounted on two sheets, that has a lamina 75 cm. in length and with a stout stipe 65 cm. long. Except for its greatly enlarged size, its relations are with this species. At least without more data we would not care to separate it. It has 36 pinnae, the lowest 18 × 3 cm. with four or more rows of small sori on either side. It is more than probable that Fée's illustration of *P. juglandifolia* Gen. Fil., *pl. 22 B. f. 1.* is taken from this species rather than the one he attempts to illustrate.

4. PHANEROPHLEBIA NOBILIS (Schlecht.) Fée, Gen. Fil. 282. *pl. 22 B. f. 2.* 1852.

Aspidium nobile Schlecht. Linnaea, **5**: 610. 1830.

Rootstock stout, creeping, the bases of the stipes with large shining brown scales: stipes 22–30 cm. long, pale brown: leaves 40 cm. or more long, with 15–23 pinnae which are 12–15 cm. long, 2.3–2.8 cm. wide, with obliquely obtuse bases and tapering curved apices; margins spiny, the spines more pronounced in the upper half of the pinna: veins free, about three times forked, the first branch bearing the sorus below the middle: sori small or medium-sized, in about three rows, the innermost row less than 2 mm. from the midrib.

Apparently confined to central Southern Mexico. Specimens have been seen as follows:

MEXICO: San Nicolas, Bourgeau, 1049 (K, N, G, C, E*). *San Luis Potosi:* Schaffner (K, U). *Mexico:* Circa urbem Mexici, Schmitz, 26 (K). *Vera Cruz:* Oaxaca, Galeotti, 6554 (K); [Laguna de la Haciendo, Schiede]. Cañada, Bilemek, 474 (G, K); Orizaba? Müller, 48 (E); Cordoba, Bourgeau, 1645 (N).

This species can be easily distinguished from *P. remotispora*, which it closely resembles in size and habit, by its free veins and its inner row of sori located near the midrib. The original was collected by Schiede and Deppe as noted above.

5. **Phanerophlebia umbonata** sp. nov.

Rootstock stout, solid: stipes 15–30 cm. long, pale brown with a few broader scattered scales in the lower portion, and a considerable number of narrow slender ones above which also appear throughout the rachis: leaves 35–50 cm. long, with 25–38 pinnae which are 9–16 cm. long, 2–2.5 cm. wide, with an acute or obtusish base and tapering apex; margins bristly, the bristles scarcely projecting; veins free, very closely placed, usually three times forked, all the branches except the first extending to the margin: sori in about two rows, with a few scattering outliers, the innermost row about 4 mm. from the midrib; indusia remaining flat, with a central depression, and the center elevated into a distinct umbo.

Cool shaded cañons near Monterey, State of Nueva Leon, Mexico. C. G. Pringle, 14 June, 1888.

This plant was at first considered by Mr. Davenport as distinct from *juglandifolium* as indicated in our correspondence. The plant was issued in Mr. Pringle's sets without a specific name, but Mr. Davenport finally yielded his early impression and reported it under that convenient catch-all of the genus which *juglandifolium* has become through its treatment at Kew. American botanists of the past generation have regarded this treatment as authoritative, in spite of the vigorous protests of Moore, John Smith, Fée, Fournier, Mettenius and Kunze, variously expressed in the literature of the past forty years.

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*Two pinnae "ex herb Gray."

There is nothing in the extensive collection at Kew, which numbers 43 specimens in this group, to match this species. Its relations are closest to *P. nobilis* and *P. remotispora*; from the former it differs among other points in its remote sori; from the latter in its free veins; from both in its larger number of pinnae, its scaly rachis and its very characteristic indusium.

We have seen specimens of the distribution in the Kew, Gray, Columbia, National, Eaton, Davenport and Philadelphia Academy herbaria, besides our own specimens, and they show very little tendency to vary.

6. **Phanerophlebia auriculata** sp. nov.

Rootstock short, creeping, densely covered with the bases of the persistent stipes, pale greenish, stramineous, 10–18 cm. long, with abundant dark brown lanceolate scales which become narrower above and almost hair-like: pinnae 10–16, rarely exceeding this number, forming a leaf 15–30 cm. long, the terminal practically the same size as the others, 5–7 cm. long, 2–2.5 cm. wide; lateral pinnae unequal at base, the lower angle obliquely truncate, the upper usually developed into a well-marked auricle; margins strongly serrate, sometimes more deeply incised, the teeth ending in sharp prickles projecting from the margin at an angle of 30°–40°; texture thin; veins free, 1–3-forked: sori in 2 more or less clearly marked rows with scattering sori between them and beyond the outer row.

This is the plant that has too long masqueraded as the representative of *Aspidium juglandifolium* from the Southwest, but has no close resemblance to that species, in habit, foliage, venation or texture. Although not the first collected, we shall assume Pringle, no. 831, from "cool damp cliffs, Mapula Mountains, Chihuahua, October, 1886," as the type of the species since it is more widely represented in collections and more representative. The first collected plants of this species we have seen are in Kew labeled simply Mexico, Dr. Coulter, 1713, and though possessing a greater number of pinnae (20) than the type are clearly this species. The first collection within the limits of the United States was made in Western Texas on the Mexican Boundary Survey near "Hueco Tanks and Van Horn's Wells." The only specimen from this collection is in the Columbia Herbarium and is marked *Aspidium juglandifolium* Kze., D. C. Eaton, January, 1880."

It was next collected by Mr. and Mrs. Lemmon, August 12, 1882, in "Conservatory Cañon," Huachuca Mountains, Arizona, and ten years later by Professor E. O. Wooton in the Organ Mountains, New Mexico. The range of the plant is quite circumscribed as it appears to be confined to northern Mexico and the adjacent portions of the United States. The following may be referred here.

MEXICO—*Chihuahua:* Pringle, 831 (K, G, N, C, P, U) Palmer, 450 (K, E, N, P); Hartman, 578 (K, G) (plants mostly immature).

ARIZONA: Lemmon, August, 1882 (K, E, G, U, N).

NEW MEXICO: Wooton, May, 1892 (U).

TEXAS: Mexican Boundary Survey (C).

7. **Phanerophlebia macrosora** (Baker)

Aspidium juglandifolium, var. *macrosorum* Baker, Jour. of Bot. **25**: 25. 1887.

Rootstock unknown: stipes brownish, the color extending throughout the rachis: pinnae coriaceous, brownish in drying, 2.5–3 cm. apart, 18–20 cm. long, 2.5 cm. wide, the apex tapering, the base unequally cuneate with a distinct cartilaginous margin and brownish spines throughout: veins free, 3 times forked, the primary branch rising from near the base, short, bearing the sorus near its middle: sori very large, hemispheric, 2.5 mm. in diameter, forming a continuous inner row 2 mm. from the midvein and one or two more or less irregular outer rows leaving a considerable bare space near the margin.

COSTA RICA: J. J. Cooper (K, G).

This very distinct plant was distinguished by Mr. Baker as a variety but we can discover no close relation to *juglandifolium** to which he united it. It does not appear to be closely related to any of the described species of the group, but does show a striking affinity with the next species with which it forms a somewhat natural group. It is known only from its type locality unless the imperfect specimen at Kew collected by Skinner in Guatemala should belong here. There are no specimens in the U. S. National Herbarium, although the original material was sent thence to Mr. Baker.

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* Mr. Baker's brief description is as follows: "veins all free, conspicuously raised; sori much longer [*sic*] than in the type"

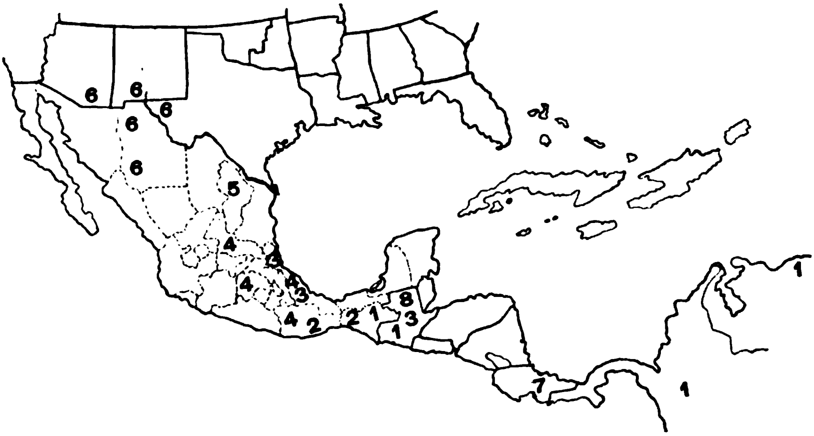
8. **Phanerophlebia Guatemalensis** sp. nov.

Rootstock unknown: stipes pale brownish, smooth: pinnae 20 × 3.5 cm., tapering at the apex, acute at base, with spinulose margins; veins free, prominent beneath in drying, four or more often five-forked: sori small, 1.2 mm. wide, mostly flattish in usually four rows either side the midvein, about equally distributed over the entire width of the pinnae: indusium small, withering.

GUATEMALA: San Miguel Uspantán, Depart. Quiché, alt. 7000. J. Donnell Smith, 3241 (G, N, P).

The specimen under this number in the Columbia Herbarium may be this species but more likely is something else. The plant is younger, the pinnae are smaller, the rachis is scaly, and its habit is quite different. There is a second Guatemalan plant in the Gray herbarium, collected by O. Salvin, that belongs here, as does another of the same collection at Kew. A tip of another specimen at Kew collected by Skinner is probably the same, although the pinnae are larger (27 × 4 cm.). The species finds its nearest alliance with *P. macrosora* but is abundantly distinct.

The geographic distribution of the known species may be compared more readily from the following map, in which the numbers of the stations correspond to the serial numbers of the species.



Distribution of the species of *Phanerophebia*: 1. *P. juglandifolia*, 2. *P. pumila*, 3. *P. remotispora*, 4. *P. nobilis*, 5. *P. umbonata*, 6. *P. auriculata*, 7. *P. macrosora*, 8. *P. Guatemalensis*.

INCERTAE SEDIS

1. *P. Lindeni* Fournier, Mex. Plantas **1**: 100. *pl. 4.* 1872.

As stated above there is considerable uncertainty regarding the relations of this species to *P. pumila*. Further collections will be necessary either to establish the validity of this species or reduce it to synonymy. Represented at Kew by Linden, 1551, collected in Chiapas.

2. In the Kew Herbarium is a specimen marked "Popocatepec., Mexique" Schaffner, no. 277, which is represented by a single leaf nearly a meter long, of which 45 cm. is stipe. The stipe is blackish at base, brownish, and then stramineous with occasional scales: pinnae 21, approximate in pairs, strongly bristly throughout, with a series of scattered scales everywhere on the veins beneath; the veins are free and the sori are in three rows very much as in *P. nobilis* which the plant resembles in many ways. Further material is here necessary to determine its position.

3. The specimens in the Kew and Gray herbariums collected by Fendler in Venezuela and distributed under no. 233 are not *P. juglandifolia* but present material is insufficent to determine its relations. It will thus be seen that while much is known of the genus, much yet remains to learn regarding complete distribution of the species.

The data presented by the above study illustrate several principles of wide application in the study of our flora, and particularly that portion of it which connects directly with the flora of Mexico and the West Indies, where, of necessity, the early types are found in the herbaria of the old world.

1. The necessity for the American flora to be monographed by Americans in whom some conception of distribution is apparent from the better perspective inherent in natives of a large country.

2. The coördinate necessity for American monographers to consult the large European collections before completing their studies of relationship and distribution. An earlier examination of Willdenow's type in this instance would have prevented much of the difficulty which has resulted from the misinterpretations of both Europeans and Americans. Few European botanists have taken the trouble to consult types on their own continent outside of the herbaria in which they work; consequently, for the study of the American flora, Americans must do this and do it systematically.

3. The uncertainty of referring to collectors' numbers unless the special herbaria in which the plant is consulted is also added. While the numbers of certain collectors are almost always homogeneous and represent a single species, those of certain other collectors are notorious for the want of uniformity of the specimens, since the commercial rather than the scientific conception has governed their distribution.

4. The crying necessity for field workers to give more attention to the subterranean portions of plants and their habits of growth. In all of the large collections of the species described above that have been examined in the best herbaria, we are still in practical ignorance of the rootstock and growth characters of nearly all the species. To understand biological characters and relationships we must know more than the average specimens of a *hortus siccus* can reveal.

Explanation of Plates

PLATE 359

1. Lower pinna of *P. juglandifolia*; the outline drawn direct from Humboldt's plant in the Willdenow herbarium.

2. *P. pumila* from Chiapas, Ghiesbreght.

3, 4. *P. auriculata* from Chihuahua, Pringle, showing different development of the basal auricle.

5. *P. umbonata*, Monterey, Pringle.

All the figures are natural size.

PLATE 360

1. *P. juglandifolia* from Humboldt's plant in the Willdenow herbarium.

2. *P. auriculata.*

3. *P. remotispora.*

4. *P. umbonata.*

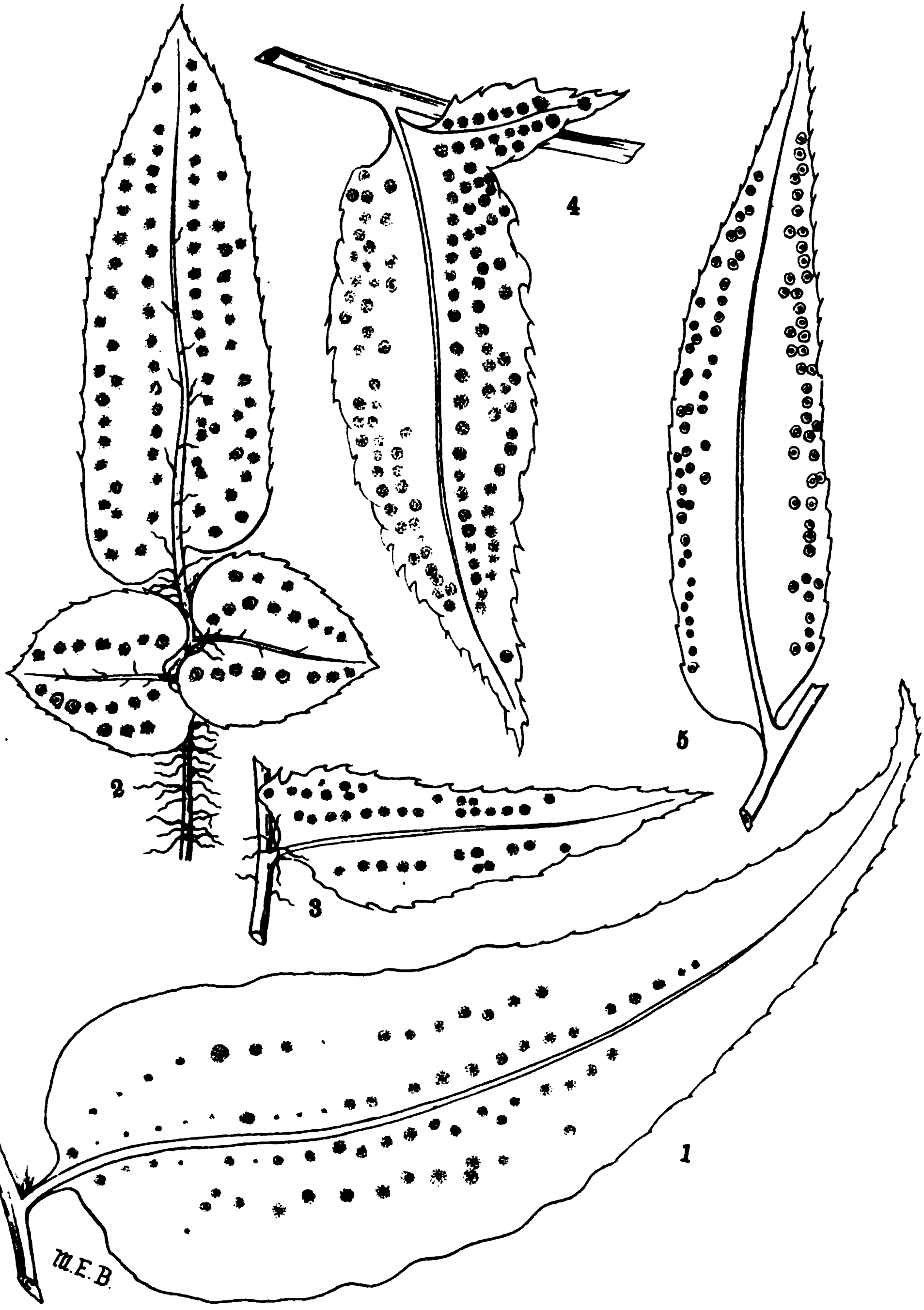
5. *P. nobilis.*

6. *P. nobilis*, from the same leaf as No. 5 but slightly more magnified.

The figures were drawn from the leaves by direct tracings with a Leitz projection apparatus, and are magnified about 2½ diameters.

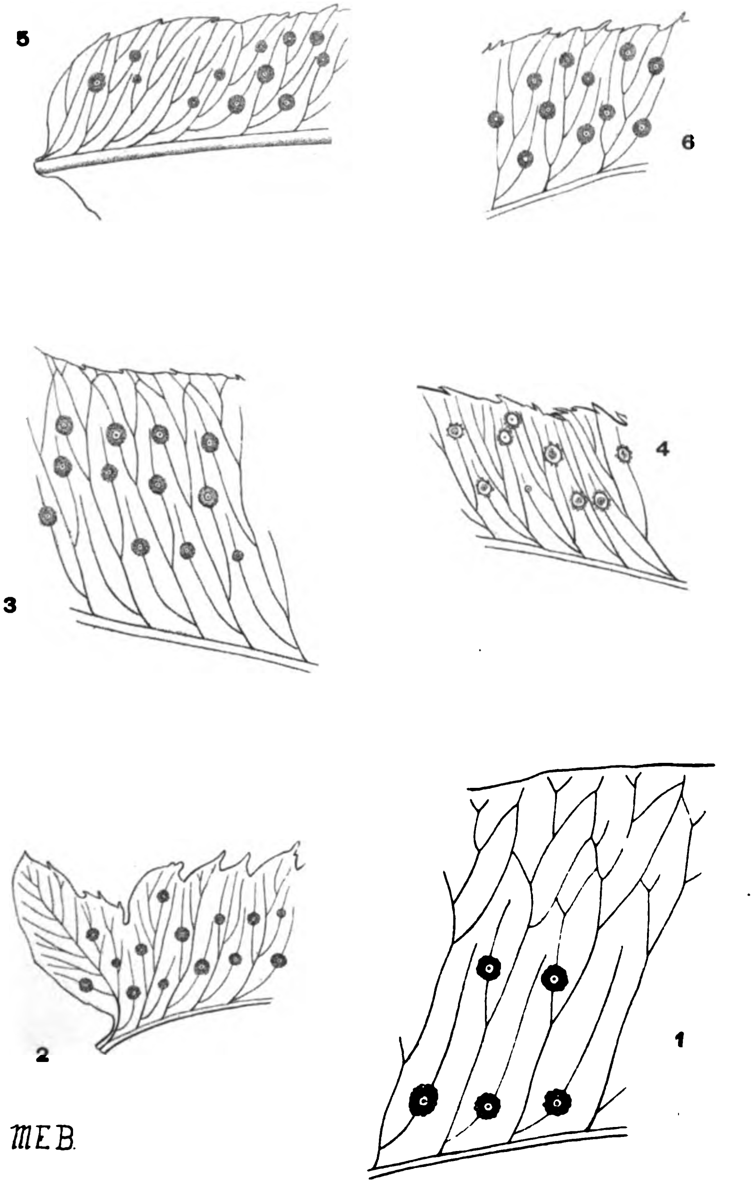
Both plates were drawn under my direction by Miss M E. Baker.

COLUMBIA UNIVERSITY, 4 April, 1899.



PHANEROPHLEBIA.

THE HELIOTYPE PRINTING CO., BOSTON



PHANEROPHLEBIA.

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The Publications of the Department of Botany, Columbia University, consist of Memoirs in quarto and Contributions in octavo.

The Memoirs already published are:—

Vol. I. **Small.** A monograph of the North American species of the genus *Polygonum.* pp. 178. 84 plates. 1895. Price, six dollars.

Vol. II. **Rydberg.** A monograph of the North American Potentilleæ. pp. 224. 112 plates. 1898. Price, six dollars.

The Contributions have now reached the seventh volume.

Vol. I. Nos. 1–25 (1886–1892). Out of print, except Nos. 6, 7, 11, 17, 20, 21, 22, 24. These can be supplied at twenty-five cents each, except No. 6, which is one dollar.

Vol. II. Nos. 26–50 (1892–1894). Nos. 26, 28, 29, 32, 33, 34, 36 39 and 48 are out of print. Other numbers can be supplied at twenty-five cents each, except No. 35, which is one dollar and a half.

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Lists of titles of Contributions may be had on application.

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 157

STUDIES IN SISYRINCHIUM—I: SIXTEEN NEW SPECIES FROM THE SOUTHERN STATES

BY EUGENE P. BICKNELL

NEW YORK
1899

[Reprinted from the Bulletin of the Torrey Botanical Club. **26** : *217-231.* 15 May, 1899.]

Studies in Sisyrinchium—I: Sixteen new Species from the Southern States

By Eugene P. Bicknell

Only a few years ago our familiar Blue-eyed Grass was looked upon as a plant common to nearly all parts of North America and as being the only one of its genus occurring in all that wide extent of country except in the farthest west.

The species—actually the extensive *group* of species—has thus been altogether misunderstood.

Nearly ten years ago Dr. Watson, after a critical study of eastern plants, announced that two forms might fairly be regarded as distinct; but this view was not generally understood, and Dr. Morong, who examined the problem in the interest of the A. A. A. S. "List," published in 1893–4, reached the conclusion that but one eastern species should be accepted.

A familiar acquaintance with the forms occurring about New York City enabled me, two years later, confidently to define three eastern species and to intimate that yet others awaited critical discrimination. It was then my hope that the subject would be taken up by some one having wider opportunity for study, but as no new word on blue-eyed grasses had been said up to the present year, while the need of a better understanding of them had been pressingly brought to my attention, the study of our species was resumed. It seems, however, that the group has not been so entirely neglected as had been believed. This appears from a recent signature of "Pittonia," wherein Professor Greene adds five species to the number known from North America. Three of these are well known to me as excellent species. Two of them come within the scope of the present paper, one a strongly characterized Floridan plant, well named *S. xerophyllum*, the other from Louisiana, *S. Langloisii*, which from the description is evidently quite different from anything that has come under my notice.

The present series of papers may be taken as preliminary to a general review of the genus in North America.

My acknowledgments to many friends and correspondents for the loan of indispensible material must be deferred to the final writing.

Sisyrinchium corymbosum

Tall and long-leaved, 30–62 cm. high, in scant tufts not fibrose at base, arising from distinct ascending rootstocks, the crowded roots becoming coarse and woody. Plant pale dull green and glaucescent, turning yellowish or brownish-green in drying, the spathes and bracts of the inflorescence sometimes purplish-tinged: leaves decidedly equitant at base in stout plants, stiffly erect and thickish, or becoming so, some of them usually surpassing the first node of the stem, closely striate, not rugulose, the edges smooth or nearly so or upwardly ciliolate towards the very acute apex: stem 2–4 mm. wide, flattened, the stem proper often much broader than the firm wing-margins, the sharp edges smooth or nearly so: inflorescence long-branched, fastigiate-subcorymbose, two or three times compound, the second series of branches and the peduncles in clusters of two or three or more, arising from short sheathing bracts; branches 7–14 cm. long to the slender peduncles which are about as long and more or less serrulate: lowest bracteal leaf foliaceous, erect, 4–8 cm. long, those above much reduced and bract-like, 1.5–3.5 cm. long, usually clasping for about half their length and oppositely bi-carinate at base: spathes erect or deflected, small and narrow, mostly 12–15 mm. long, the nearly equal bracts thin and membranous, delicately nerved, acute or subulate, the margins rather broadly white-hyaline, the outer one tubular-clasping for at least one third its length; interior scales much shorter than the bracts: flowers blue, small, numerous, 8–11, on exserted, slightly spreading pedicels, 10–15 mm. long, becoming 15–22 mm. long in fruit; perianth delicate, apparently only 8–10 mm. long; stamineal column 3–4 mm. high: capsules broadly oblong, 3–5 mm. high, thick-walled, becoming dark brown; seeds globose, 1 mm. in diameter, faintly pitted or nearly smooth.

Florida: "Pine barrens near Jacksonville," A. H. Curtiss, "no. 4584, Curtiss' Second Distribution of plants of the southern United States," March 17, 1894, just in flower; June 1, 1894, over-ripe fruit. In Herb. U. S. National Museum.

Alabama: Mobile, Dr. Chas. Mohr, "Damp grassy banks:" just in flower April 5, 1897. In Herb. Dr. Chas. Mohr. Apparently a reduced form of the type, more slender and less branched, with elongated bracteal leaf.

A fine species, when well developed much the largest of the genus in the eastern United States. It is well characterized by its branched, sub-corymbose, bracteate inflorescence and long stiffly erect leaves.

Sisyrinchium solstitiale

Known only in its early-flowering stage. Thinly tufted from erect woody rootstocks, the very slender roots long and wiry, the bases of the tufts clothed with chaffy and loosely fibrillose remains of decayed leaves. Stems and leaves pale dull green or glaucescent, turning dull brownish-green in drying: leaves very straight and erect, 15–25 cm. long, about half the height of the plant, very narrow when young, becoming 4 mm. wide, evenly graduated to the stiff acicular apex, striate, the nerves mostly prominent and obscure in an alternating series, the intervals minutely transversely rugulose; margins of the leaves for a width of about .5 mm. thinner and paler than the interior portion in evident contrast, at least in the dried plant, the extreme edge hyaline and minutely serrulate, becoming smooth; stems once or twice spirally twisted, forming an erect double curve, 20–46 cm. or more tall, becoming 3 mm. wide, the firm wings hyaline-margined and obscurely serrulate, becoming smooth: inflorescence elongated, narrow, from three rather remote nodes, each supporting an erect, foliaceous bracteal leaf and one or two peduncles, or the lower one bearing a slender branch having a bracteal leaf and two peduncles: spathes dull green, straight, 2–2.5 cm. long, the bracts stiff, closely striate-nerved, subequal, acute or aculeate, the outer one narrowly acuminate, its margins below white-hyaline, united around the inner for 6–8 mm., or over one third of its length; interior scales acuminate, finally equaling the bracts: flowers blue, rather strongly veined, apparently few, about 12 mm. long, on erect slightly exserted pedicels.

Collected by Mr. Geo. V. Nash in high pine land at Eustis, Lake Co., Florida, Aug. 10, 1894, the first flowers just opened. Type in herbarium Geo. V. Nash.

A very distinct species remarkable for its late flowering period. *S. xerophyllum* Greene, which occurs at the same locality, flowers in March, five months earlier in the season.

SISYRINCHIUM XEROPHYLLUM Greene, Pittonia, **4**: 32. 17 M. 1899.

Tufts coarsely brown-fibrose at base from compound woody rootstocks, each separate stem arising from a short annular caudex: stem and leaves dull brownish-green, glaucescent, turning dark brown, stiff, closely striate, transversely rugulose or granulose between the nerves, the edges rough-serrulate or becoming nearly smooth: leaves stiff and erect, becoming flexuous in withering, attenuate-acute, 2–4 mm. wide, 25–45 cm. long: stems 15–35 cm. high, 2–3 mm. wide, prominently winged, above passing into an erect, often elongated, bracteal-leaf subtending a lateral-appearing cluster of 2–6 short-peduncled spathes and rarely also a branch bearing shorter peduncles; peduncles narrowly wing-margined, the edges obscurely roughened or becoming smooth, 2–6 cm. or even 10 cm. long, slightly curved, approximate and subequal, the outer two or three arising from a cluster of bracts borne on a very short prolongation of the stem. At flowering time the spathes are contiguous in a subsessile cluster: spathes erect or deflected, 14–19 mm. long, 3–4 mm. wide, dull green or slightly purplish, the bracts conspicuously hyaline-margined, subequal, stiff-herbaceous, striate-nerved, somewhat carinate, rather rigidly acuminate, the outer one sheathing for 2–4 mm. at base: interior scales crowded, at maturity exserted: flowers numerous, 8–12, rather large, violet; perianth delicate, becoming 12 mm. or more long; stamineal column 5–6 mm. high: capsules on pedicels 15–20 mm. long spreading or recurved from the tip of the spathe, 4–6 mm. high, trilobate-obovoid or subglobose, impressed at base and retuse, drying dark: seeds black, rugulose, becoming over 1 mm. in longer diameter.

The type is Nash's no. 133, "Plants of Central Peninsular Florida" collected in vicinity of Eustis, Lake County. This distribution furnished many excellent specimens in flower and early fruit collected, "March 20, 1894, in dry, sandy soil along road in high pine land region."

The Philadelphia Academy Herbarium has a specimen just in flower collected March 5, 1888, at Okahumpka, Sumpter County, by Isaac Burke.

The earliest collector of the plant would appear to have been Chapman, judging from an old sheet bearing his signature, now in the Herbarium of Columbia University, labeled "Florida, on Sand Hills, 1842."

On the strength of this specimen I drew attention to the plant three years ago in the paper previously referred to and published a brief description. The present description, which was ready for the press when the plant received its recent christening by Professor Greene, is given in full, being based on fairly extensive material, including flowers and fruit which Professor Greene had not seen.

Sisyrinchium tortum

Stiff and erect in thin tufts coarsely fibrous at base arising from a dense cluster of rather stout fibrous roots; 15–30 cm. high, not turning dark in drying; leaves firm, the larger ones equaling the stems or nearly so, finally close-striate and faintly vermiculate-rugulose between the nerves, like the stems mostly 1.5–3 mm. wide with the edges smooth or obscurely denticulate-roughened; stem wing-flattened, usually one to four times spirally twisted and sometimes forming a shallow sigmoid curve; node usually only one, bearing a short erect bracteal leaf subequal with the two peduncles or shorter; occasionally a lower node bears two longer and more slender erect peduncles; bracteal-leaf with a broad clasping base which is strongly striate and oppositely more or less bicarinate; terminal peduncles two, rarely three, short, 2–5 cm. long, parallel or divergent, usually slightly unequal; spathes usually abruptly broader and thicker than the peduncles, 10–16 mm. long, becoming 3 mm. wide; bracts subequal or either one the longer, rather thin and membranous, striate-nerved, the outer one obtuse, or sometimes acute, the margins broadly hyaline, sometimes to the apex, united-clasping for 1–3 mm. at base; inner bract often broadly obtuse and scarious at apex; interior scales narrow and attenuate, shorter than the bracts; flowers pale blue on slender, loosely erect, finally exserted pedicels 15–22 mm. long; perianth 8–10 mm. long, the rather broad segments very delicately nerved; stamineal column short, 2–4 mm. high. Capsule not seen.

Mississippi and Florida: Biloxi, Miss. Professor S. M. Tracy, March 15 and 20, 1898, just in flower. St. John's River, Florida, in Herb. Acad. Nat. Sci. Philadelphia, a single specimen on a sheet bearing also specimens of *S. xerophyllum* Greene, and *S. Floridanum*, the former collected by Isaac Burke in 1888.

Apparently nearest *S. xerophyllum* Greene, but unmistakably distinct.

Sisyrinchium Carolinianum

In loose tufts fibrose-coated at base, arising from erect or ascending rootstocks, the roots thickly clustered and rather coarsely fibrous, plant pale and glaucescent, often rather a bright yellowish green; leaves often much shorter than the stem, though sometimes reaching the first node, rather thin and openly erect, rather weakly striate-nerved, mostly 2–3 mm. wide or a few much broader, even 5 mm. wide, acuminate, the margins usually distinctly serrulate: stems erect, 2–3 mm. wide, broadly winged, the edges mostly serrulate or even ciliolate; nodes of stem one or two, each bearing a foliaceous bracteal leaf and two or three rather long more or less diverging peduncles; prolongation of stem beyond the first node commonly 5–7 cm. long and somewhat outcurved; peduncles 4–8 cm. long, often ciliolate-denticulate: spathes green or sometimes purplish, as a rule not at all deflected, 15–20 mm. long, the bracts sub-equal or either one slightly the longer, varying from herbaceous-attenuate to scarious-obtuse and mucronulate; interior scales about half the length of the bracts: flowers 3–8, on very delicate slightly exserted, loosely erect pedicels; perianth very delicate, pale violet-blue, 8–10 mm. long; stamineal column 4–5 mm. long: fruit not seen.

Western North Carolina and central South Carolina to Georgia, Alabama and Mississippi. Beginning to flower in the Carolinas in early May, at its southern limit a month earlier.

North Carolina: near Columbus, Polk Co., E. C. Townsend.

South Carolina: Andersonville, Anderson Co., Professor Lewis R. Gibbes, 1886. Type, in Herbarium N. Y. Botanical Garden; near Hamburg, Gibbes; Camden.

Georgia: Augusta, A. Cuthbert; Stone Mountain, Dr. Small.

Alabama: Auburn, F. S. Earle and C. F. Baker; Mobile, Dr. Chas. Mohr.

Mississippi: E. Hilgard.

Appearing somewhat intermediate between *S. graminoides* Bicknell and *S. Atlanticum* Bicknell, but perfectly distinct from both.

Dr. Mohr's specimens from Mobile and those from Mississippi are aberrant and may represent yet another species.

Sisyrinchium Floridanum

Tufts densely fibrillose at base, roots clustered, slender and wiry, stems and leaves 25–40 cm. high, pale dull green and glaucescent, not discoloring in drying, minutely crystalline-puncticulate; leaves numerous, equaling the stems or shorter, stiffly erect or ascending, becoming flexuous in withering, mostly 2–3 mm. wide, rarely 4 mm., closely and firmly striate, attenuate to the terete or sub-terete slender-pointed apex, the edges smooth; stems sub-terete with narrow but firm wing-margins, 2–3 mm. wide, the edges smooth, bearing near the top a slender, erect bracteal leaf, shorter than the 2–3 usually erect peduncles, sometimes erectly prolonged beyond the node and bearing a second cluster of three shorter peduncles; peduncles very slender, mostly less than .5 mm. wide, narrowly margined, smooth or sometimes obscurely denticulate, subequal, or usually so, 5–10 cm. long, transversely constricted below the spathe: spathes green or slightly purplish, mostly erect, narrow, 15–20 mm. long; bracts subequal, striate-nerved, hyaline margined, attenuate, mucronulate-acute or aculeolate, or the apex of the inner one apiculate from a narrowly scarious-obtuse or even bifid tip, the outer one clasping for 2–5 mm. at base; interior scales about equaling the bracts or slightly exserted; flowers 5–11, on slender exserted pedicels, pale blue, perianth delicate, about 10 mm. long: capsules pale green or purplish tinged, trigonous-subglobose or obovoid, abruptly contracted above and below, 3–4 mm. high, on pedicels 20–25 mm. long, exserted and slightly diverging for about quarter of their length: seeds not fully mature.

Based chiefly on Nash's no. 13, "Plants of Central Peninsular Florida"; collected "near Lake Dot, Eustis, on dry sandy hillside, March 12, 1894." In flower and fruit.

The same plant was collected by Prof. Underwood, also at Eustis, in 1891, and further specimens have been examined as follows: Hibernia, March, 1869, W. N. Canby; Pine Barrens near Jacksonville, March 17, 1894, A. H. Curtiss.

Sisyrinchium Nashii

Nearly related to *S. Floridanum*, but much smaller and slenderer, and flowering in June and July instead of March.

Very slender and delicate, growing in thin wisps of a few stems and leaves sheathed with a dense fibrillose coating around the base, leaves few, erect, about half the height of the stem, .5–2 mm. wide, rather less closely and strongly striate than in *S. Floridanum* and frequently denticulate, especially towards the scarcely terete apex: stems few, erect, 20–30 cm. high, mostly 1 mm. or less wide, the very narrow margins often, or usually, minutely denticulate; leaves, stems and peduncles sometimes obscurely roughened with minute points on the sides: bracteal leaf almost setaceously slender, much shorter than the peduncles; peduncles 1–3, almost filiform, often not perceptibly margined, more or less unequal, mostly 4–6 cm. long: spathes narrow, 13–15 mm. long, the bracts mostly thinner and less sharp-pointed than in *S. Floridanum*, the inner one frequently surpassing the outer and scarious-obtuse at the apex; flowers smaller than in *S. Floridanum*: capsules pale, 2–3 mm. high, subglobose or often broader than long on slenderly exserted subspreading pedicels 17–22 mm. long: seeds subglobose, black, finely rugulose-pitted, with a large umbilicus.

Based on Nash's no. 1395, "Plants of Central Peninsular Florida" collected near Lake Swatara, Eustis, in dry sandy soil of low pine land region, July 24, 1894, in flower and mature fruit; and Nash's no. 1914, collected at Eustis, June 11, 1895, in full flower and with very young fruit.

So near to S. *Floridanum* that I should scarcely have thought of looking for specific differences between the two plants but for the wide difference in their flowering periods as shown by the labels. Mr. Nash is satisfied that the plants are distinct and recalls that in the field he regarded the smaller plant of low pine land as certainly different from the similar species collected in the same region, but in high pine land four months earlier in the season.

Sisyrinchium rufipes

Early flowering stage: Thinly tufted from ascending rootstocks, the old leaves disintegrating to form a loose coating of bright rufous-red fibers about the base of the plant. Stem and leaves rather bright pale green and glaucescent partly turning a dull brownish green; leaves very slender, about the height of the stem, straight and erect but becoming widely flexuous in withering, 1–1.25 mm. wide, slenderly attenuate, more or less granular-scabrous between the close nerves, the margins finely sharp-serrulate; stems erect, about 1 mm. wide, narrowly margined, the edges closely appressed ciliolate-serrulate; bracteal leaf slender and erect, subtending two short suberect or outcurved peduncles and sometimes also a branch bearing a bracteal leaf and two short-peduncled spathes; branches and peduncles hirsutulous-ciliolate on the edges and often roughened with minute points on the sides: spathes short, about 12 mm. long, the bracts somewhat divergent, sharp-acuminate or the inner one scarious-obtuse and apiculate, the outer one hyaline margined below and slightly sheathing at the base: flowers 2–5, small, blue, on delicate slenderly exserted pedicels 15–17 cm. long; perianth about 8 mm. long; stamineal column 4 mm. high.

Georgia: Augusta, A. Cuthbert, "dry sand hills," March 24th. In herbarium J. K. Small.

Imperfect specimens from Summerville, South Carolina, collected by Professor Lewis R. Gibbes, April 9, 1850, just in flower, are probably to be referred here. They are more slender than the type with flexuous stems and leaves, and are nearly smooth throughout, but with the bracts minutely granular-scabrous.

In Herb. N. Y. Botanical Garden.

A specimen in Herb. U. S. Nat. Mus. no. 220, 346, wet pine barrens, Craven County, North Carolina, July 3d (G. McCarthy) doubtless also belongs here, but shows a mature plant of very different aspect. The stems are tall, and about twice spirally twisted, the tallest 47 cm. high and bearing at the node two slender peduncles and a longer divergent branch terminating in a cluster of three peduncles; the spathes are slenderer and longer than in the type, with narrow stiffly attenuate slightly unequal bracts. The capsules are brown and thick-walled, ovoid subglobose, and 3.5 mm. high; the immature seeds are rugulose-pitted and about 1.25 mm. in diameter. The stem and leaves, slightly broader than in the type, have dried very dark, but they show the same character of densely ciliolate-serrulate margins and also indications of granulose roughening on the sides; the fibrous tuft at the base of the plant is of much the same character as in the type but of a duller, more brownish color.

Sisyrinchium fuscatum

Growing in thin tufts, 15–50 cm. high, fibrose about the base, and arising from rather stout rootstocks and clustered widely spreading fibrous roots. Plant dull green and glaucescent, crystalline puncticulate, discoloring in drying, sometimes becoming almost black: leaves long and slender, but shorter than the stems, firm and erect, becoming flexuous, .5–2.5 mm. wide, acute or slenderly subterete at the apex, strongly close-striate, the edges smooth or denticulate-roughened: stems long and slender, erect, .75–2 mm. wide, at least the wings distinctly striate, the edges minutely denticulate, becoming smooth; bracteal leaf short, and erect, attenuate above, the broader basal portion strongly close-striate, surpassed by the two closely approximate and subequal, erect, slender peduncles, which are subterete and only 2–6 cm. long: spathes erect, narrow, but abruptly wider than the constricted peduncle, 15–18 mm. long, the bracts equal or nearly so, stiffly herbaceous and firmly close-striate, closely approximate, cuspidate-acuminate, the outer one clasping for 2–4 mm. at base; interior scales much shorter than the bracts: flowers 5–8, blue, on erect, more or less exserted pedicels, 18–25 mm. long; perianth about 10 mm. long, the segments narrow, rather closely and strongly nerved: capsules 2.5–4 mm. high, broadly subglobose, drying dark.

Western Florida to Mississippi.

Flowering from March to May.

Florida: Apalachicola, Chapman.

Alabama: Flomaton, Escambia county, April 23, 1898, C. F. Baker.

Mississippi: Biloxi, Prof. S. M. Tracy; Ocean Springs, Miss Skehan.

I find two sheets of this species in Herb. Missouri Botanical Garden, "ex coll. D. V. Dean," but without other record.

Sisyrinchium flagellum

Very slender and flexuous in thin tufts, not fibrose at the base, the roots becoming rather coarsely fibrous; pale dull green and slightly glaucescent, darker in drying, 20–32 cm. high. Leaves as long as the stems or nearly so, narrow and flexuous, 5–1.5 mm. wide, distinctly rather few-striate, smooth-edged or serrulate at the attenuate acute apex: stems erect, usually more or less flexuous, and geniculate at the nodes, .75–1.5 mm. wide, narrowly wing-margined, smooth-edged; nodes one or two, remote, the lowest about midway in the stem or higher, supporting a long leaf and one or two long slender peduncles, the upper node bearing a shorter leaf and two or three peduncles; peduncles very long and slender, 5–12 cm. long, mostly .5 mm. wide, smooth-margined, subequal, approximate or slightly divergent: spathes often abruptly deflected, narrow, 15–20 mm. long, the bracts slightly keeled to the apex, subequal or the inner one longer, the outer one narrowly acuminate and sharp-pointed, hyaline-margined below and clasping for 5–7 mm. at base; the inner one often scarious margined to the abruptly mucronulate apex; interior scales much shorter than the bracts: flowers not well made out, of some shade of blue and apparently of medium size: capsules 4–6 on erect slightly exserted pedicels 18–20 mm. long, trilobate-subglobose, retuse and impressed at base, about 4 mm. high, drying brown, the surface minutely rugulose: seeds globose, finely alveolate, 1 mm. or more in diameter.

South and West Florida: "Pine Key, Blodgett." In Herbarium of Columbia University.

Manatee County, Dr. J. T. Rothrock; "open glades," March 5, 1887; in flower and fruit. Specimens in herbarium of College of Pharmacy, New York and Philadelphia Acad. Nat. Sci.

Sisyrinchium Miamiense

About 20 cm. or more high, growing in small erect tufts from short descending rootstocks, the roots long, somewhat woody and nearly simple. Plant apparently dull green and glaucescent, drying dark: leaves erect, about three quarters the height of the plant, 1–1.5 mm. wide, cuspidate-acute, with somewhat thickened corneous tips, rather strongly but not very closely striate-nerved, serrulate: stems rather loosely erect, about the width of the leaves, distinctly wing-margined, denticulate-serrulate, bearing two or three erect peduncles at the top and sometimes an ascending branch lower down; peduncles approximate, 3–7 cm. long, their margins serrulate to smooth: spathes mostly erect, 13–15 mm. long, the bracts rather sharply keeled to the apex, the outer one stiffly acute, slightly hyaline-margined below and clasping for 1–4 mm. at base, slightly surpassing the inner, which is scarious-obtuse at the apex and apiculate; flowers 5–8, blue, apparently of medium size; capsules on exserted pedicels 15–18 mm. long, 3–5 mm. high, trigonous-obovoid or somewhat pyriform, mucronulate, thick-walled, brown, minutely rugulose: seeds irregularly subglobose- and bluntly angled, 1–1.25 mm. in diameter, faintly rugulose- pitted, obscurely umbilicate.

Southeast Florida; Miami, Dade County, Charles L. Pollard and G. N. Collins, April 4–7, 1898; Plants of subtropical Florida, no. 264; last flowers and mature fruit.

Sisyrinchium scoparium

Pale green and glaucous, growing in close tufts fibrose at base, from contracted rootstocks and rather coarsely fibrous roots, 15–50 cm. high. Leaves erect and very slender, equaling the shorter stems of the tufts but much shorter than the longer ones, 1 mm. or less to 1.75 mm. wide, very acute, the edges sometimes obscurely roughened; stems equally narrow with the leaves, very smooth, the striate wing-margins sometimes obscurely roughened above on the edges; inflorescence when well-developed appearing somewhat flabellately short-branched from two often approximate nodes of the stem, the lower node bearing one or two short, slender peduncles, the upper one two or three shorter peduncles; the peduncles and short branch all slightly diverging; bracteal leaves slender, rarely surpassing the spathes: peduncles 2–5 mm. long or the lower ones longer, denticulate on the margins; sometimes the stems bear but one node and two short peduncles; spathes erect, 12–18 mm. long, the bracts rather strongly close-striate, acuminate, subequal, the tips finally spreading; outer one narrowly hyaline-margined below, clasping for 2–5 mm.; interior scales about three quarters the length of the bracts; flowers 6–11, violet blue; perianth apparently with rather narrow segments, about 10 mm. long; capsules clustered on fascicled distinctly margined pedicels 14–20 mm. long, somewhat obovate or oblong-subglobose, 2–5 mm. high, thick-walled and drying dark, remaining slightly puberulent at maturity: seeds globose, black, finely pitted, 1 mm. in diameter.

Coast of Mississippi. Flowering from March to May.

Biloxi, April 27, 1898, C. F. Baker. Type in Herb. Alabama Biological Survey, no. 1496, also Biloxi, April 2, 1898, S. M. Tracy.

Sisyrinchium implicatum

Growing in close tufts from contracted rootstocks and producing a dense entangled mass of slender fibrillate roots; often assurgent at base, the numerous weak stems flexuous-erect or spreading in a loose entanglement, pale dull green, perhaps slightly glaucescent. Leaves very slender, weakly erect or flexuous, .5–1 mm. wide, 5–15 cm. long, narrowly blunt-pointed or acute, finely close-striate, the edges smooth, or serrulate when young: stems equally slender with the leaves narrow-margined, the edges smooth or obscurely denticulate, geniculate near the top at the single node and bearing 1 or 2 short peduncles with deflected spathes; peduncles almost capillaceous, margined slightly curved or straight, approximate, 2–4 cm. long, surpassing the slender bracteal leaf: spathes very small, the bracts somewhat membranous and finely nerved, equal, or either one slightly longer than the other; the outer one 10–15 mm. long, contracted-clasping for 3–5 mm. at base, narrowly acute, hyaline-margined below; inner bract acute or scarious-obtuse and apiculate: flowers 3–5, small, on pedicels slightly exserted or scarcely so; perianth very delicate and faintly nerved, pale blue, apparently about 8 mm. long; stamineal column about 5 mm. high.

Mississippi: Calhoun Co., "Wet bottoms," April 1858, E. Hilgard. In Herbarium Missouri Botanical Garden.

Sisyrinchium rosulatum

Prostrate or ascending in rosulate tufts, or sometimes nearly erect, pale dull green or glaucescent not turning dark in drying, the denser tufts from contractedly short-branched woody rootstocks, the roots delicate and fibrillate: tufts sometimes very small, becoming 25 cm. in diameter: basal leaves short, 2–8 cm. long, 1–2 mm. wide, the broadened base membranous and hyaline-margined, the weak nerves becoming rather distant, in larger leaves .5 mm. apart: apex of the leaf apiculate acute or sometimes more attenuate, the margins denticulate to closely sharp-serrulate or even sub-ciliolate: stems of the smaller tufts very short, only 6–30 mm. long, often concealed by the leaves, bearing one or two much longer peduncles: stouter plants may become 20 cm. high, the stems with two remote nodes each supporting an erect leaf and mostly two peduncles, or rarely the lower node developing a slender erect branch: stem slender, subterete, narrowly margined, the edges denticulate-serrulate: stem leaves much shorter than the peduncles, rather broadly flat-sheathing for 10–15 mm. above the node: peduncles long and slender, approximate or diverging, 2.5–10 cm. long, often more broadly margined than the stem, the edges aculeolate-denticulate: spathes relatively large, straight or deflected slightly transversely constricted at base, mostly about 2 cm. long, both bracts somewhat foliaceous, the outer one more attenuate and usually slightly the longer, rarely both bracts broadly foliaceous and prolonged, the inner one hyaline-margined nearly to the top, the outer one below the middle: flowers not seen, reported to me by Dr. Mohr as being of a reddish-purple or wine color: capsules 3–5. broadly subglobose, 2.5–3.5 mm. high on capillary flexuously spreading pedicels 2–3 cm. long, pale, but purplish-tinged along the sutures: seeds numerous, very small, .5–.75 mm. long, finely alveolate, umbilicate, assymetrically cuneate and angled.

Dry open places in sandy soil, coast of South Carolina and Alabama.

South Carolina: Sullivan's Island, May 8, 1852, Professor Lewis R. Gibbes. In fruit. In Herb. N. Y. Botanical Garden.

Alabama: Mobile, April 6, 1896, May 5, 1896, Dr. Charles Mohr. In fruit. In Herb. Dr. Mohr and Missouri Botanical Garden.

Very distinct from any of our eastern species, having its affinity with certain South American forms and a Mexican and Central American species which is perhaps unnamed.

Sisyrinchium furcatum

Loosely tufted, from rather stiff nearly simple fibrous roots, 10–15 cm. high; dull green, drying rather dark, mostly purplish about the nodes and bracts. Leaves about the height of the plant, erect, attenuate-acute, .5–1.5 mm. wide, rather thin, finely striate-nerved, the edges obscurely denticulate-roughened to smooth: stems 1–1.5 mm. wide, the wing-margins distinctly several-striate and denticulate, casually simple but commonly forking into 2 or sometimes 3 peduncles 3–6 cm. long, subtended by a slender, erect, bracteal leaf of about equal length: spathes relatively broad, about 3 mm. wide across the middle, the bracts delicately nerved and thin membranous on the sides, with broadly hyaline margins, mostly acuminate, the outer one usually prolonged beyond the inner 3–6 mm. and clasping for 2–3 mm. at base, the inner one often emerging rather abruptly; interior scales rather broad, brownish-tinged, much shorter than the bracts: flowers 4–6, blue; perianth very delicate and faintly nerved, 8–10 mm. long; stamineal column 4–5 mm. high: fruit not seen.

Southeastern Louisiana: Hammond, Tangipahoa Co., Lewena Gallup, April 4, 1889, "pine lands," in full flower. In U. S. Nat. Herb.

Sisyrinchium sagittiferum

Thinly tufted and slightly fibrillose at base, apparently not glaucous, drying dark, 10–15 cm. high. Leaves about equaling the stems .5–1.5 mm. wide, thin, striate-nerved, acuminate, the edges serrulate to smooth: stems very slender, .5–.75 mm. wide, margined to narrowly winged, the wings distinctly striate, mostly denticulate-roughened or above even papillose-aculeolate on the edges; spathes small, erect, terminating the stems and four or five times as broad, subequal or the outer one prolonged: outer bract 11–27 mm. long, acuminate or attenuate, sometimes surpassing the inner bract 15 mm., the white-hyaline margins only slightly united at base; inner bract 10–12 mm. long, the margins broadly white-hyaline, the apex abruptly acute or broadly scarious and truncate or emarginate with excurrent midvein: interior scales equaling the inner bract or nearly so: flowers 3–7, small, on almost hair-like flexuously exserted pedicels about 15 mm. long: perianth apparently about 8 mm. long, color faded out; stamineal column 4 mm. high: capsules undeveloped.

Texas, May, 1839, Dr. Ridell. In Herb. Dr. Chas. Mohr.

Sisyrinchium scabrellum

Caespitose in close erect tufts, arising from a dense cluster of fibrous roots, 25–40 cm. high, slightly fibrillose at base; dull pale green and glaucescent, the spathes often yellowish green and purplish, the rather long sheathing bases of the leaves purplish-tinged. Leaves stiffly erect, three quarters the height of the stem, very narrow, 1–2 mm. wide, tapering and cuspidate-acute, closely striate, scabrous all over or even canescently incrustate with minute setulose papillae, less so or quite smooth above, sometimes nearly smooth throughout: stems simple, stiff and slender, 1–2 mm. wide, flattened, sometimes glabrate but usually scabrous, at least below, sometimes equally so with the leaves, the finely-striate wing-margins roughened on the edges or even minutely hispidulous-aculeolate: spathes geminate at the top of the stem (in one instance three together) sessile or the outer one short-stipitate, the bracts herbaceous and striate, encrusted with minute whitish points or almost hispidulous-scabrous; primary bract stiff and erect, much elongated, 3.5–11.5 cm. long, slenderly attenuate, or broadened and foliaceous above the spathe, usually smooth or nearly so above; inferior outer bract attenuate, often slenderly prolonged, 1.2–3.8 cm. long, surpassing the inner bracts, which are less herbaceous, scarious-margined and acute or mucronulate; interior scales shorter than the inner bracts: flowers 3–6, pale blue, on slender, loosely erect or flexuous, much exserted pedicels 1–2 cm. long; perianth delicately membranous, 8–12 mm. long; stamineal column 4–6 mm. high. Mature fruit not seen.

North Carolina: Buncombe County, near Biltmore, May 10, 1898, in full flower, ex. Biltmore Herbarium; Stanley County, at the Falls of the Yadkin River, April 20–24, 1896, just in flower. John K. Small.

Dr. Small's specimens are darker green and much less scabrous than those from Biltmore, with larger and more foliaceous primary bracts and thicker roots.

The Publications of the Department of Botany, Columbia University, consist of Memoirs in quarto and Contributions in octavo.

The Memoirs already published are:—

Vol. I. **Small.** A monograph of the North American species of the genus *Polygonum*. pp. 178. 84 plates. 1895. Price, six dollars.

Vol. II. **Rydberg.** A monograph of the North American Potentilleæ. pp. 224. 112 plates. 1898. Price, six dollars.

The Contributions have now reached the seventh volume.

Vol. I. Nos. 1–25 (1886–1892). Out of print, except Nos. 6, 7, 11, 17, 20, 21, 22, 24. These can be supplied at twenty-five cents each, except No. 6, which is one dollar.

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STUDIES IN SISYRINCHIUM—II: FOUR NEW SPECIES FROM MICHIGAN

BY EUGENE P. BICKNELL

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Studies in Sisyrinchium, II:—Four new Species from Michigan.

By Eugene P. Bicknell

As represented in Michigan the genus *Sisyrinchium* presents some altogether unexpected features. As many as eight species occur in the state, that is to say, eight species are included among several small collections of Michigan Blue-eyed Grasses which have been sent to me; it is quite probable that the actual number of species belonging to the state flora is even in excess of this. Two of the species are the now well known *S. angustifolium* and *S. graminoides*, common in the eastern states; two are long discredited species which must be restored to good standing—the *S. mucronatum* of Michaux, described in 1803, and the *S. albidum* of Rafinesque, published in 1832; about these I shall have more to say on another occasion; the remaining four species are here described.

It does not yet appear which are the prevailing species in the state. *S. graminoides* seems to have been the most frequently collected, occurring both north and south, but it is apparently quite wanting in certain sections. *S. albidum*, which is common further south, seems to prevail in the southern part of the state, where it has been collected by Professor Wheeler, Mr. Farwell and the Misses Camp; Mr. Farwell has also obtained it in Keeweenaw County in the extreme north. *S. angustifolium*, common eastward, and also to the north and west, appears to occur only sparingly. The four new species must be regarded for the present as rare, each having been collected only at a single station.

Sisyrinchium hastile

Very slender and rigidly erect, apparently little if at all tufted, 30–40 cm. high, dull green becoming brownish in drying. Leaves very narrow and stiff, thickened, 1 mm. or less wide but becoming over 30 cm. long, tapering into a very slender, obtusely pointed, sometimes terete apex, very closely striate-nerved, granulose-roughened throughout with minute whitish points, except the broadened and membranous sheathing base; stems resembling the leaves, equally slender and granulose, rigid and very straight, or sometimes twisted and undulate, strongly striate, not at all winged but subterete and bluntly two-edged or obscurely margined: spathes in a conjugate pair at the top of the stem, or sometimes solitary, the outer one stoutly short-stipitate within the base of the common outer bract, each spathe consisting of two opposite pairs of closely imbricated bracts 2–3 cm. long which are attenuate-lanceolate, stiff-membranous and striate, with hyaline margins, the inner pair tapering into weak white-scarious acuminations, all glabrous or the outermost obscurely roughened, the common outer bract very slenderly prolonged for half its length and surpassing the inner ones 1–5 cm.; interior scales ample, sometimes slightly exserted, the larger ones even appearing like inferior bracts: flowers apparently only 1–3 in each spathe, on erect, scarcely exserted pedicels 1.5–2.3 cm. long, mature flower not seen; a dried and brown bud from within a spathe showed unusually long and narrow anthers (4.5 mm. long) cleft for the insertion of the short, partly free filaments, and slender styles about 2 mm. long not, however, surpassing the stamens: young capsule obovate-oblong, dark, rugulose.

Described from a few imperfect specimens communicated by Mr. O. A. Farwell, who collected them June 6, 1896, on "sandy shores of Belle Isle, in the Detroit River, Michigan."

A remarkable plant not closely related to any of our species, but showing a number of striking peculiarities and even possessing claims to generic distinction.

Sisyrinchium Farwellii

Thinly tufted from a cluster of very slender wiry roots which are dark and finely striate when dried, the bases of the tufts sheathed with a coating of coarse dull-brown fibers. Leaves and stems rather light dull-green and slightly glaucescent, not blackening in drying, the spathes paler yellowish-green: leaves apparently not more than half the height of the stem, becoming 3 mm. wide, firm in texture though rather thin and membranous, finely nerved, attenuate-acute, the edges smooth or serrulate: stems flexuous-erect, 20–30 cm. high, 1–2 mm. wide, the wings thin and finely nerved, minutely aculeolate-serrulate or sometimes smooth below; bracteal leaf shorter than the two or three peduncles, slenderly attenuate, below rather abruptly broadened and loosely clasping, the membranous sheathing base striate-nerved, the keel sometimes very rough-serrulate, stem sometimes bearing two rather distant nodes each with its leaf and peduncles: peduncles 4–11 cm. long, somewhat curved, approximate, very slender, mostly less than .5 mm. wide, narrowly thin-margined, smooth to ciliolate-serrulate, sometimes serrulate only on one side: spathes narrow but abruptly broader than the peduncles, erect or slightly bent, 17–20 mm. long, bracts sub-equal or the outer one slightly prolonged, thin and membranous, narrowly hyaline margined finely or sometimes obscurely nerved, narrow and attenuate, slender-pointed or sub-aristulate, or the inner one mucronate from a scarious apex, the outer one clasping for 2–3 mm. at base: interior scales about half the length of the bracts: flowers 5–9, pale-blue, very small; perianth appearing to be only about 6 mm. long, very delicate and faintly-nerved: capsules pale and thin-walled, 3–5 mm. high, on slender, somewhat flexuously-erect, exserted pedicels, 17–25 mm. long.

Southeastern Michigan, Birmingham, Oakland County, September 27, 1898, O. A. Farwell.

Very distinct from any species of the Eastern States, appearing to group more naturally with the fibrous-based *S. Floridanum* and allied species of the South.

Sisyrinchium strictum

About 30 cm. high in close tufts not fibrous-coated at base, pale, bright green and glaucous, keeping its color when dried, the spathes often purple and sometimes the entire plant purplish-tinged. Leaves over half the height of the stems, closely erect, rather thin, but firm and closely striate-nerved, 1–2 mm. wide, slenderly acute, the edges minutely serrulate to smooth; stems about 1.5 mm. wide, the wing-margins rather thin, mostly serrulate; node only one, bearing a slender erect bracteal-leaf, shorter or longer than the mostly two short, erect, approximate peduncles which are narrowly wing-margined with denticulate edges: spathes erect, narrowed into the peduncle, 16–20 mm. long, 1.5–3 mm. wide, the bracts subequal, but usually the inner one slightly surpassing the outer and obviously the broader above, acute or mucronulate, rather openly fine-nerved, almost carinate, the dorsal line of the outer bract usually showing a more or less abrupt descent into the acuminate apical part, the margins below slightly hyaline, united for about 5 mm. above the base; interior scales small, half the length of the bracts or less: flowers 3–6 on erect, slightly exserted pedicels 20–23 mm. long; perianth deep blue-purple, apparently about 10 mm. long; stamineal column about 5 mm. high; pedicels distinctly margined or even winged, the exserted tips becoming purple: a single capsule is truncate obovate, pale and thin-walled over 4 mm. high: seeds not quite mature, oblong, dark and rugulose-pitted, 1–1.25 mm. in longer diameter.

Vestaburg, Montcalm County, Michigan, collected by Professor C. F. Wheeler, June 22, 1898, "in sandy soil well in the southern limits of the white pine country."

Appearing somewhat intermediate between forms of *S. Atlanticum* and *S. mucronatum* Michx., but unmistakably distinct from either.

Sisyrinchium apiculatum

Loosely tufted from contractedly branched rootstocks and slender wiry roots, pale green and glaucescent not turning dark when dry, about 40 cm. high. Leaves loosely erect, apparently few and less than half the height of the stems, 1.5–2 mm. or more wide, acute, thin but firm, closely striate-nerved, very smooth-edged, somewhat withering-persistent and becoming loosely flexuous and fibrillose about the base of the tufts; stems erect, 1–2 mm. wide, narrowly winged; nodes mostly two, separated by an interval of 4–6 cm., the lower bearing a foliaceous erect bracteal-leaf and one or two peduncles often much surpassing the second node, which supports a short bracteal leaf and two or three peduncles; peduncles very slender, narrowly margined, smooth or finely denticulate, distinctly constricted at the base of the spathe, erect or divergent, those from the first node sometimes 8 cm. long, the upper ones shorter: spathes often deflected, short and relatively broad, 10–13 mm. long, 2–3 mm. wide, the bracts subequal, mostly incurved above, acute, or the inner one sometimes obtuse, prominently striate, broadly hyaline-margined, convex and sharp-edged, the inner one emerging rather abruptly above the clasping base (3–4 mm. long) of the outer one; interior scales rather broad and blunt, much shorter than the bracts, flowers about 6, blue, rather small; perianth about 8 mm. long; stamineal column about 4 mm. high; ovary glandular-puberulent: capsule dark, broadly subglobose, apiculate, sparsely puberulent, on loosely erect, distinctly margined pedicels, 13–17 mm. long.

Muskegon, Muskegon Co., Michigan, June, 1898, communicated by Professor W. J. Beal.

In appearance perhaps most suggestive of *S. Atlanticum*, but not at all that species.

The Publications of the Department of Botany, Columbia University, consist of Memoirs in quarto and Contributions in octavo.

The Memoirs already published are:—

Vol. I. **Small.** A monograph of the North American species of the genus *Polygonum*. pp. 178. 84 plates. 1895. Price, six dollars.

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The Contributions have now reached the seventh volume.

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NTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 159

STUDIES IN SISYRINCHIUM—III: ANGUSTIFOLIUM AND SOME RELATED SPECIES NEW AND OLD

BY EUGENE P. BICKNELL

NEW YORK
1899

nted from the BULLETIN OF THE TORREY BOTANICAL CLUB. **26**: *335–349.* 18 July, 1899.]

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Studies in Sisyrinchium.—III: S. angustifolium and some related Species new and old.

BY EUGENE P. BICKNELL.

The common Blue-eyed Grass of the eastern states, *Sisyrinchium angustifolium* Miller, may be taken as representative of a section of the genus *Sisyrinchium*, embracing those species having simple leafless stems with terminal spathes. The group of species so characterized, if not strictly a natural one, forms, nevertheless, a well-marked assemblage in the genus which it is altogether convenient to recognize. Nor is this subdivision entirely without natural status, for, taking the genus in North America as a whole, the degree of branching shown by the different species is seen to be correlated to some extent with their distribution. Thus the simple-stemmed species are, as a group, of more northern and alpine distribution than those which develop pedunculate spathes from one or more leaf-bearing nodes, while, on the other hand, the species having a definitely compound system of branching are all distinctively southern.

Little inconvenience appears to have resulted from our imperfect knowledge of this particular group of Blue-eyed Grasses, for long-established practice in the matter of identification has referred the simple-stemmed plants, one and all, to the species *S. angustifolium*, under whatever name designated. A very interesting series of distinct species has thus been overlooked.

No account is here taken of the northwestern *S. grandiflorum*

[Issued 18 July.]

Dougl., which forms a genus clearly distinct from *Sisyrinchium*, nor of the yellow-flowered California species, *S. Californicum* Dryand and *S. Elmeri* Greene, which again are not of the same generic type as our blue-flowered species. This matter will be discussed in a subsequent paper.

SISYRINCHIUM ANGUSTIFOLIUM Miller, Dict. ed. VII. 1759.

S. Bermudiana L. Sp. Pl. 954. In part. (?) 1753.

S. gramineum Lam. Encyc. **1**: 408. 1783.

S. anceps Cav. Diss. **6**: 345. *pl. 190, f. 2.* 1788.

S. montanum Greene, Pittonia, **4**: 33. 1899.

Tufted, or sometimes of scattered habit, commonly 20–30 cm. high (8–56 cm.) stiff and erect, more or less glaucous. Leaves usually ½ to ¾ the height of the stem and 1.5–2.5 mm. wide (1–3.5 mm.) linear and attenuate or sometimes slightly broadened upwards and acuminate, the edges usually serrulate-roughened: stems simple and leafless, or occasionally bearing a single leaf subtending one or two branches 5–12 cm. long, 1–2 mm. or even 3 mm. wide, wing-margined, the wings equaling or broader than the width of the proper stem, rarely narrower, more or less serrulate or denticulate-roughened, apparently never wholly smooth in the eastern plant: spathes erect, green or sometimes purplish-tinged; outer bract 2–6 cm. long, surpassing the inner one 1.5–4 cm., rarely less than twice its length, slenderly attenuate or broader and more abruptly acute, obscurely hyaline-margined, clasping for 2–6 mm. at base; inner bract 1.5–3 cm. long, hyaline-margined, acute to narrowly attenuate; interior scales silvery white, narrow, usually about half the length of the inner bract: flowers 1–8, violet-blue; perianth 10–12 mm. long; stamineal column 4–6 mm. high; pedicels erect or nearly so, 17–25 mm. long, shorter or slightly longer than the inner bract: capsules 4–6 mm. high, mostly oblong-subglobose and only obscurely trigonous pale, but often clouded with brownish-purple.

This species is far more widely distributed than any other one of its genus, ranging from Newfoundland and New Jersey to Saskatchewan and Montana and southward along the eastern mountains to Virginia and in the west to southern Colorado. I have seen no specimens from west of the Rocky Mountains.

It is scarcely to be thought that the species holds true throughout this wide range and indications are that, even as here limited, it is still something of an aggregate and will be found to include at least several geographical races.

The more eastern plant must, of course, be taken as typical of the species. It ranges from Newfoundland and Quebec south to New Jersey and in the Alleghanies to Virginia. Specimens from this general region show more or less discoloration from drying, but not nearly to the same extent as in *S. graminoides*. Specimens from Ontario to Saskatchewan and Colorado show little change of color on the herbarium sheet and differ further from the more eastern plant in being more glaucous and stiffer with leaves of rather thicker texture. Several specimens from British America are unusually slender and apparently small-flowered. Others from Minnesota are unusually stout and glaucous, and with some uniformity have the spathes brightly colored with red-purple quite in contrast with anything seen from elsewhere, although the eastern plant sometimes has the spathes tinged with dull purple. Still other specimens from Minnesota are tall and slender and apparently scarcely glaucous, the spathes long and narrow, the flowers on very slender pedicels and with delicately membranous perianth.

Several collections from Nebraska, well illustrated by Rydberg's no. 373 from Banner Co. and no. 1251, "Flora of the Sand Hills," are noteworthy by reason of stout central stem with relatively narrow and smooth-edged wing-margins, rather long pedicels and subglobose, corrugated capsules. Several of these specimens are branched. I have little doubt that this plant is entitled to a distinctive name.

Specimens collected in Newfoundland by Dr. Robinson and Mr. Schrenk are very small throughout with thin broadly winged stem and thin leaves, the capsules only 2 mm. high or less and on somewhat spreading pedicels; these specimens show quite as much discoloration as *S. graminoides*. Specimens from Mt. Desert Island, Maine, collected by Rand and Redfield are well developed examples of the usual eastern plant, and New Brunswick and Prince Edward Island specimens are similar.

The species comes into flower in most sections of its range from the middle of May till the middle of June, or later at high elevations. In the neighborhood of New York flowering is sometimes over in the second week of June. As far east as Newfoundland the flowering period is much later, from the end of June until late August, as shown by the collections of Waghorne and Robinson and Schrenk.

SPECIMENS EXAMINED.

Virginia: Mountain Lake, 4,000 ft. alt. Britton.

Pennsylvania: Pike Co., E. P. B.

New York: N. Y. Co., E. P. B.; Westchester Co., Mrs. E. G. Britton; Greene Co., Miss A. M. Vail; Chemung Co., Lucy; Chenango Co., Stewart; Tompkins Co., Rowlee, Kilbourne; Onondaga Co., Brower; Oswego Co., DeForest; Otsego Co.; Washington Co., Fitch.

Massachusetts: Berkshire Co., "1828"; Hampden Co., Rusby; Bristol Co., Sturtevant; Middlesex Co., Underwood; Essex Co., Oakes.

New Hampshire: Cheshire Co., Churchill.

Maine: York Co., Hill, E. P. B.; Mt. Desert, Redfield, E. P. B.

New Brunswick: Goodwin.

Prince Edward Island: Macoun.

Newfoundland: Robinson and Schrenk, Waghorne.

Quebec: Danville, Berg; Montreal, Kelly.

Ontario: Lambton Co., Dodge; Jones Falls, Fowler; Toronto Island, Armstrong; Casselman, Macoun; Lincoln and Welland McCalla.

Michigan: Jackson Co., Camp.

Assinoboia: Crane Lake, Macoun.

Saskatchewan: Bourgeau, 1858.

British America: Dr. Richardson.

Minnesota: Aitken Co.; Cass Co., Anderson; Cook Co., Cheney; Crow Wing Co., Sheldon; Lake Co., Sandberg; Mille Lacs, Sheldon; Pipestone Co., Menzel; St. Louis Co., Arthur.

North Dakota: Grand Forks Co., Bannon.

South Dakota: Black Hills, Rydberg, W. S. Rusby; Beadle Co., Douglass.

Montana: Park Co., Tweedy; Belt River, Williams; Custer, Blankinship; Madison and Gallatin Cos., Rydberg.

Nebraska: Ft. Union and Badland Creek, Hayden, 1853-4; Sheridan Co., J. G. Smith and Pound; Sioux Co., Williams; Banner Co., Rydberg; Cherry Co., Wilcox.

Colorado: North Boulder Peak, 6,500 ft., Pinard; Canyon City, Brandegee; Pike's Peak, Trelease; Ft. Collins, 5,000 ft., Baker; Table Rock, Crandall: Clear Creek, Englemann; South

Park, Wolf and Rothrock; Lorimer Co., 9,000 ft., Crandall; La Plata Mts., 9,000 ft., Baker, Earle and Tracy.

SISYRINCHIUM MUCRONATUM Michx. Fl. Bor. Am. 2: 33. 1803.

Caespitose in close tufts often loosely invested below with the tangled and fibrillose remains of withered leaves; roots numerous and matted, very slender. Leaves and stems dull-green to glaucescent, slender, the leaves commonly half the height of the stem, but sometimes equaling it, varying from capillaceous to 2 mm. wide, taper-pointed, smooth-edged or minutely denticulate or serrulate. Stems numerous, 10–46 cm. tall, varying from capillaceous and merely margined to 1.5 mm. wide and narrowly winged, the edges very smooth to denticulate-roughened, simple or occasionally short-branched at the top; spathes straight or slightly bent, the thin bracts smooth or, exceptionally, obscurely scabrous, usually or often bright red-purple, but varying to green, narrowly hyaline-margined, the outer one 1.8–5.7 cm. long, united-clasping for 1–4 mm. at base, the slender prolongation surpassing the inner bract 4–28 mm.; inner bract emerging gradually from the outer one, 10–16 mm. long, herbaceous, attenuate and acute, or the apex obtuse and scarious or even bifid; interior scales narrow and attenuate, mostly about half the length of the inner bract. Flowers 2–7, mostly deep purple-blue, sometimes white; perianth 6–14 mm. long; stamineal-column 4–5 mm. high: capsules on slender somewhat spreading pedicels 1–2 cm. long, 2–4 mm. high, trigonous, subglobose, broadly oblong, or somewhat obovate, not impressed at base, sometimes even narrowed into the pedicel, thin-walled, pale but usually purplish-tinged at maturity; seeds subglobose, black, pitted and prominently umbilicate, 1–1.2 mm. in diameter.

Southeastern Michigan and Ontario to eastern Pennsylvania, Washington, D. C., and Virginia, in meadows and grassy places or sometimes in dry soil. Flowers in May and June, beginning about the middle of May in the neighborhood of Washington; fruit ripe early in July in the Alleghany region of east Pennsylvania.

Michigan: St. Clair Co., C. K. Dodge; Ontario: Lambton Co., C. K. Dodge, Wingham, J. A. Morton; New York: Ithaca, Herb. Cornell Univ.; Pennsylvania: Union Co., H. R. Noll; Monroe Co., N. L. Britton, E. P. B.; Pike Co., E. P. B.; Philadelphia, A. B. Monoy; Isaac P. Martendale (1872); Washington, D. C.: Lester F. Ward, G. McCarthy; Virginia: Dyke, T. H. Kearney, Jr.

It is at last possible to understand this long misdoubted species of Michaux and to dispel the uncertainty which has always attached to the exact application of its name. The species is a perfectly authentic one and has failed of recognition evidently because never properly distinguished from the commoner and far more widespread *S. angustifolium*, a plant of similar habit, but stouter and more glaucous and differing especially in its much larger fruit.

While the distinctness of these two plants is not at all a matter of doubt, the variation of *S. mucronatum* is so considerable that, in order to define that species understandingly it will be well to give sharper definition to the type as contrasted with certain stouter forms of the plant which take on more the likeness of *S. angustifolium.* Michaux's description can no longer be misunderstood and the type of *S. mucronatum* may be confidently taken as the smallest form of the plant markedly set apart by almost capillaceous stem and leaves, small flowers and conspicuously red-purple spathes. This is an exceedingly delicate and attractive little plant rendered especially striking by its close and numerous capillary appearing stems tipped with the bright-colored spathes. In this extreme form of the plant the tufts are but 10–20 cm. high and the leaves and stems only .5–1 mm. wide, the latter merely margined and with the edges mostly very smooth. The leaves, commonly about one half the height of the stems, are erect and almost setaceous, the edges sometimes obscurely roughened at the apex. The narrow spathes have the outer bract 12–24 mm. long and aristulate-prolonged for 5–12 mm. beyond the inner one which is scarious-obtuse or bifid at the apex and apiculate from the midnerve; the flowers are few and small, the perianth appearing to be only 6–8 mm. long, on capillary, exserted, somewhat spreading pedicels 10–16 mm. long, fruit not seen.

In this typical state the plant cannot possibly be confused with any other species; nevertheless it appears to pass into an every way larger form the extreme state of which simulates forms of *S. angustifolium* from which, however, the smaller, more globose fruit readily distinguishes it. The stoutest example seen, from Washington, D. C., has larger flowers than occur in any other eastern species the perianth being 12–14 mm. long.

A form of the plant found by Dr. Britton and myself fruiting in abundance in a damp meadow near Tannersville, Pa., July 4, 1896, is tall and slender the numerous leaves nearly as long as the stems, many of which bear a bracteal leaf near the top subtending one or two peduncles. The plants were pale in color and the more branched forms bore rather a close resemblance to forms of *S. Atlanticum.*

In two or three of many specimens the bracts of the spathe are very obscurely scabrous.

The forms of the plant here referred to look remarkably different from the type, but the extremes appear to intergrade and the expediency of recognizing any of them as varieties does not clearly appear from the material at present before me.

Sisyrinchium campestre sp. nov.

Closely caespitose, commonly 15–20 cm. high (10–30 cm. or more) erect, stiff, glaucous or glaucescent. Leaves half the height of the stem or longer, sometimes surpassing the stem, 1–1.5 mm., rarely 2 mm. wide, the edges smooth, the bases tinged with pale dull purple: stem .5–1.5 mm. wide, narrowly wing-margined, the wings finely close-striate, often obscurely scabrous on the sides, especially above, the edges smooth; spathe pale dull purple to green, the bracts minutely roughened with somewhat glandulose points to canescently scabrous-puberulent, or sometimes glabrous, primary bract 2.5–4.5 cm. long, narrowly attenuate, often setaceously slender, stiff and straight or slightly incurved, obtuse or acute, surpassing the inner bract 1–2.5 cm., the margins narrowly hyaline below, not at all united-clasping at the base or but slightly so; base of inner bract usually rounding out rather abruptly from the primary one, especially at full maturity, giving the spathe a somewhat gibbous character, the bract 1.2–2 cm. long, narrowed or slenderly attenuate to the acute apex, the edges noticeably white-hyaline; interior scales commonly broader than in *S. mucronatum:* flowers 4–9, pale blue to white; perianth delicate, 8–14 mm. long; stamineal column 3–5 mm. high; pedicels 10–16 mm. long, usually not surpassing the inner bract and little spreading: capsules pale at maturity, 2–4 mm. high, trigonous-subglobose, often depressed, and impressed at base but sometimes cuneate-obovate, sparsely puberulent, minutely rugulose, sometimes also venose-reticulated; seeds few in each cell, 1–1.25 in longer diameter, irregularly obovoid-subglobose or oblong, somewhat angled, black, at full maturity, only faintly pitted umbilicate.

Wisconsin to North Dakota, south to Louisiana, Oklohoma and the mountains of New Mexico, on prairies, in meadows and in rocky open woods, flowering in May and June.

Wisconsin: Madison, Trelease.

Minnesota: Chicago Co., Taylor; Goodhue Co., Sandberg; Hennepin Co., many collectors; Meeker Co., Frost; McLeod Co., McElligott; Nicollet Co., Ballard; Ramsey Co., Sheldon; Swift Co., Payne; Waseca Co., Taylor.

North Dakota: Geyer (1839).

South Dakota: Clay Co., Geyer; Lincoln Co., Redfield.

Nebraska: Lancaster Co., Webber; Saline Co., Siegreist, Hayden (1853).

Missouri; Atchison Co., Bush; Jackson Co., Bush; Jefferson Co., Englemann (1862).

Kansas: Riley Co., Bassler, Norton.

Arkansas: Nuttall.

Oklahoma: Waugh.

New Mexico: Hermit's Peak, Snow.

Illinois: Menard Co., Hall.

Iowa: Fayette Co., Fink; Pottawattamie Co., Hayden; Story Co., Hitchcock; Winneshiek Co., Collett.

Louisiana: Natchitoches Co., Hale.

Nearly allied to *S. mucronatum* Michx. certain forms of the two plants even appearing scarcely different—always a logical expectation from conditions of close relationship between plants, however distinct. Notwithstanding such dubious forms, the normal development of the two plants takes place along obviously different lines. In its typical state *S. campestre* is mostly a more glaucous plant than *S. mucronatum*, of stiffer habit, with smooth-edged stem and leaves, and paler blue or frequently white flowers on rather less exserted pedicels; the spathe is relatively larger with stiffer primary bract, and though often of a dull pink-purple shade never develops the bright red-purple color so conspicuous in typical *S. mucronatum*; its bracts are also usually less membranous than in *S. mucronatum*, the outer one scarcely if at all united-clasping at the base permitting a more abrupt protrusion of the inner one which tends to be more broadly hyaline along the margins.

The close relationship of the species to *S. mucronatum* would lead to an expectation of somewhat parallel lines of variation in the two plants. These, indeed, prove to exist. Furthermore, *S. campestre* is nearly related to the twin-spathed species, *S. albidum*

Raf., just as *S. mucronatum* is nearly related to the twin-spathed *S. scabrellum*, only with this reversal in the terms of the relationship that, in the one case the rough-bracted plant is the one with the solitary spathe, in the other case the one with the spathes geminate.

Several more or less well-defined strains of variation may be traced running through herbarium material of *S. campestre*, but there is no sufficient evidence that these represent anything more than mere states of the species, any one of which might appear under the appropriate conditions of soil and situation.

The form taken as typical has the stem 1–1.5 mm. wide, commonly much surpassing the slightly broader leaves, and densely scabrous-puberulent spathes often of a pale purple color, the primary bract acute or obtusely pointed and surpassing the inner bract 1–2 cm., the inner bract 1–2 cm. long, herbaceous attenuate or hyaline-margined to the acute apex, the flowers usually light-blue and about 10 mm. long on slender pedicels subequal with the inner bract.

This plant is common in Minnesota, extending west to the Dakotas and south to Missouri and Kansas.

A few specimens from Minnesota are unusually stiff and glaucous, with the perianth sometimes 14 mm. long.

Certain other specimens are greener, the spathes showing little or no purplish tinge, the inner bract often broader and having the more scarious margins somewhat abruptly narrowed to the shorter tip.

A small proportion of specimens have the bracts quite smooth. Such plants seem to be rare as far north as Minnesota, but more frequent further south; they show a tendency to a slightly broader stem than the type, especially near the base of the spathe, and broader inner bract, and are frequently white-flowered, apparently representing a transition to the variety *Kansanum* described below. Specimens of this smooth-bracted plant are, on technical characters, sometimes with difficulty separable from *S. mucronatum*, but as a rule are rather stouter, with smooth-edged stem, stiffer leaves, broader inner bract and less united outer one.

Differing strikingly from the type when extreme forms are compared but appearing to intergrade with it is a very slender form which is frequent or common in Minnesota and Missouri. The leaves are relatively long and with the stems mostly less than 1 mm. wide, the spathes small and slender in proportion, the outer bract and frequently the inner one very slenderly attenuate. Certain of these slender specimens from Minnesota have numerous unusually elongated leaves considerably surpassing the stems, very short spathes and pedicels and capsules only 1.5–2.5 mm. high; some of these specimens have no purplish tinge in the bracts and appear to be scarcely glaucescent; rarely their bracts are quite glabrous.

Sisyrinchium campestre Kansanum var. nov.

Pale and glaucous, rarely showing any purple tinge in the bracts, 15–30 cm. high. Leaves stiff and erect, straight or falcate, often equaling the stem, 1–2.5 mm. wide, closely striate, mostly cuspidate-acute, smooth-edged, sometimes when young roughened on the sides with minute points: stems 1–2 mm. wide, the wings mostly wider than the proper stem and perceptibly broadened into the base of the spathe, striate, the edges smooth; sides of the stem sometimes minutely roughened especially near the top: spathes stiffly erect, the broad base appearing abruptly transverse across the top of the stem, the bracts herbaceous and striate, smooth or rarely obscurely scabrous; primary bract stiff, erect or curved, slenderly prolonged, 2.5–6.5 cm. long, surpassing the inner bract 1.2–3.0 cm., blunt-pointed or slenderly acute, the margins below narrowly white-hyaline, usually not at all united at the base; inner bract 1.5–2.7 cm. long, broad below and abruptly emerging from the outer one, keeled, herbaceous-attenuate or the broad white-scarious margins abruptly narrowed to the obtuse or merely acute apex. Flowers white, large, the perianth delicate, sometimes over 14 mm. long, its divisions obovate-oblong, apparently not emarginate and very short aristulate; stamineal column 4 mm. high; pedicels 12–17 mm. long, shorter than the inner bract, more or less margined: capsules apparently not larger than in *S. campestre*, trilobulate-subglobose, 3–5 mm. high, glandular puberulent when young; mature seeds not seen: roots stronger, darker and less fibrillose than in *S. campestre*.

Eastern and middle Kansas and Oklahoma, doubtfully from southeastern Nebraska and western Missouri, occurring on prairies and flowering from the middle of April into June. Kansas: Davis Co., Ft. Riley, April 27, 1892, type, in Herb. Columbia University; Riley Co., J. B. Norton, T. Bassler; McPherson Co., J. E. Bodin; Douglas Co., "J. G. B." Oklahoma: "Waugh."

In its fully developed state this plant presents so striking a contrast with usual forms of *S. campestre* that there would seem to be little doubt of its being a distinct species; nevertheless, forms apparently intermediate between the two occur with them. It is evidently impossible to determine the exact status of the plant from present material.

Sisyrinchium flaviflorum sp. nov.

Tufted, about 25 cm. high, dull green and glaucescent; older roots coarse and simple or nearly so. Leaves about three-quarters the height of the stems, 1–2 mm. wide, the larger ones broadened upwards, acute, striate, the edges nearly or quite smooth: stems 1.25–2 mm. wide, stiff and erect or sometimes curved, broadened into the base of the spathe, the wings prominently striate, smooth-edged; spathes green, 4–5 mm. wide near the base; primary bract very large and foliaceous, often curved, about 6 cm. long, obtusely pointed, surpassing the second bract 3–4 cm., very narrowly hyaline below, the margins free to the base; inner bract 2–2.5 cm. long, hyaline-margined, herbaceous attenuate to the obtuse apex, emerging rather abruptly from the base of the spathe: flowers apparently few on pedicels 10–15 mm. long, much shorter than the inner bract; perianth clear lemon yellow, about 12 mm. long, apparently of rather thick texture and minutely granulose-glandular, the divisions abruptly rounded or truncate at the tip, very short aristulate; column about 5 mm. high; anthers rather large, 2–2.5 mm. long, apparently less contiguous than in allied species with the filaments less coherent at the top; young capsules obovate-oblong, glandular-puberulent.

Missouri: Courtney, B. F. Bush. Type in Herb. Missouri Bot. Gard., June 7, 1892, just in flower.

Similar in general appearance to large examples of *S. campestre Kansanum* but of a peculiar dull green color with larger spathes and especially larger and more foliaceous primary bract. The flowers, however, afford the most distinctive feature of the plant and appear to be peculiar in texture as well as in color, and in larger anthers as compared with related forms.

Mr. B. F. Bush, of Courtney, Missouri, the discoverer of this interesting plant appears to be the only person who has ever met with it. Specimens sent by him some years ago to the Gray Herbarium were referred to by Dr. Watson as being probably a form of *S. angustifolium* (Gray's Manual, ed. 6, 735).

Mr. Bush writes me in regard to this plant that it grows in open Black Jack woods on the borders of prairies, while *S. angustifolium* (*S. campestre*) grows on bare prairies and *S. graminoides* in wet meadows. It does not occur with either of the other two species and only occurs in two or three localities near here, Courtney, Mo.

SISYRINCHIUM ALBIDUM Raf. Atl. Jour. 17. 1832.

Dull or rather bright green, the spathes often tinged with dull red-purple, glaucous or glaucescent, commonly 30 cm. or less high (15–46 cm.). Leaves about half the height of the stem, mostly 1.5 mm. wide (.5–3.5 mm.), very acute, smooth-edged, but often serrulate above or sometimes throughout: stems commonly 1.5 mm. wide (1–3 mm.), often very flat, the wings thin and striate, usually broader than the proper stem, serrulate or hispidulous on the edges or sometimes smooth: spathes two, contiguous and sessile at the top of the stem or rarely the outer one pedunculate on a short divergent branch, each two-bracted; primary bract 2.5–7 cm. long, foliaceous or slenderly attenuate, acute or obtuse, surpassing the inner bracts 1.2–5 cm. the edges free to the base and scarcely hyaline; outer bract of second spathe 1.3–2.7 cm. long, hyaline-margined, the tip herbaceous, sometimes obtuse, but usually acute or attenuate, subequal with its fellow or surpassing it by as much as 12 mm.; keels of inner bracts often ciliolate; interior scales about three quarters the length of the shorter bracts: flowers varying from clear white to violet-blue, sometimes as many as nine in each spathe; perianth 8–12 mm. long; stamineal column 4–5 mm. high: capsules pale, rather thick walled, depressed-subglobose, 2–3 mm. high on slender, erect, or slightly spreading pedicels 10–22 mm. long, little if at all longer than the shorter bracts: seeds black, globose, prominently umbilicate, distinctly pitted .75–1 mm. in diameter.

Alabama and Louisiana to Missouri and Michigan; North Carolina. Flowering in early April in the extreme south, in April and early May as far north as southern Illinois, in late May and early June in northern Illinois and Michigan.

Alabama: Tuscaloosa Co., Dr. E. A. Smith.

Mississippi: Oktibbeha Co., S. M. Tracy.

Louisiana: Dr. Hale.

Tennessee: Sewanee, E. Kirby Smith.

North Carolina: Stanly Co., W. W. Ashe.

Kentucky: Dr. C. W. Short (1840); Warren Co., Miss Sadie F. Price.

Missouri: St. Louis Co., Dr. Englemann (1838–1865).

Illinois: Hancock Co., S. B. Mead (1842); Cook Co., Dr. W. Moffat.

Indiana: Tippecanoe Co., A H. Young.

Michigan: Cass Co., C. F. Wheeler; Jackson Co., C. F. Wheeler, S. H. & D. R. Camp; Ingham Co., C. F. Wheeler; Livingston Co., C. F. Wheeler, Belle Isle, Detroit River, O. A. Farwell; Keeweenaw Co., O. A. Farwell.

It is difficult to frame an exact definition of this plant from present material which, while fully attesting the distinctness of the species from the old *S. angustifolium* and the more nearly related *S. campestre*, appears to point to a still further problem in segregation while not permitting its solution. In appearance the plant is similar to *S. angustifolium* or, in its more slender forms, to *S. campestre* but differs from both in its uniformly twin spathes and from the former in mostly white or pale blue flowers and smaller fruit.

The type locality for the species is West Kentucky and specimens from this general region have been more particularly held in view in the foregoing description. So far as specimens and notes on labels indicate the plant is here uniformly white-flowered. Specimens from prairies near Chicago have large very pale blue flowers and unusually long bracts, which on a few of the plants are obscurely scabrous on the sides, a feature shown only by one other specimen of my series, also from Illinois.

From Sewanee, Tenn., comes a specimen having apparently very small blue flowers and capsules but 1 mm. or less high. The only specimen seen from Louisiana is very pale in color and has stout spathes with long, slenderly attenuate primary bracts; the apparently small flowers are white on somewhat slenderly exserted pedicels. Specimens collected in Mississippi by Prof. S. M. Tracy are noteworthy from their large size and broad leaves and stems, the former becoming 3.5 mm. wide; the spathes are unusually stout, the pale blue flowers seemingly of medium size. Contrasting so markedly with these as to seem quite distinct yet apparently connected by intermediate forms, are certain specimens from Michigan communicated by Professor C. F. Wheeler and Mr. O. A. Farwell. These are extremely slender, the stems and leaves from .75–1.5 mm. wide, the spathes abruptly broader than the stems and with the outer bracts unusually slender and elongated; the blue flowers are rather small and delicate. Some of these specimens seem to be scarcely if at all glaucous and with thinner leaves and bracts than other forms; the stems are mostly only narrowly winged.

Sisyrinchium heterocarpum sp. nov.

Apparently but little tufted, bright green or yellowish green, glaucous, stiff and erect, 20–30 cm. high; roots pale, fleshy, tapering from thickened bases sometimes 2 mm. wide. Leaves half the height of the stem or longer, 1–2 mm. wide, tapering, acute, the edges smooth: stem 1–1.5 mm. wide, narrowly winged, the edges smooth or bearing some minute harsh points towards the base: spathes sometimes slightly purplish tinged, erect, narrow, sometimes scarcely exceeding the width of the stem, sometimes becoming 2–3 mm. wide about the middle; inner bract often weakly developed or inconspicuous, 1.5–2 cm. long, scarious-margined usually to the acute apex; outer bract 2.5–4.5 cm. long, above slender and acute, surpassing the inner bract 1–2.5 cm., the lower margins hyaline, united for 3–5 mm. at base: perianth violet-purple, about 10 mm. long; stamineal column 5 mm. high: capsules of two kinds, terminal and basal, the latter more or less concealed among the bases of the leaves, those from the terminal spathes few, 1–4, pale, subglobose or sometimes obovoid, rather large, 5–7 mm. high on erect scarcely exserted pedicels only 10–20 mm. long; basal capsules 2–4, on slender erect pedicels 2.5–3.5 cm. long, obovoid-pyriform, 7–10 mm. long from the narrowed base, 4–5 mm. wide, rather thinner walled than the terminal ones and more or less transversely corrugate conformably with the position of the seeds, a feature less evident in the terminal capsules: seeds (not quite mature) black, obovoid-subglobose, angled and rugulose-pitted, stipitate, 1 mm. in diameter.

Wyoming: Cummins, July 30, 1895, in full flower and with immature fruit; Table Mountain, June 30, 1895, in full flower and with immature fruit; Dubois, August 10, 1894, nearly mature fruit and immature flower buds.

An interesting plant known only from the collections of Professor Aven Nelson. In general aspect of leaf and stem it closely matches slender forms of *S. angustifolium* to which species it is evidently nearly allied.

The development of basal flowers and fruit is an unexpected character in the genus and were it shown by a single specimen only might reasonably be referred to an abnormal condition. It is however exhibited by five perfectly healthy examples collected at different times in three distinct localities.

The origin of these basal flowers may perhaps be referred to suppressed development of the usual stem. They occur either in separate leaf clusters or among the leaves about the bases of normal stems, but in the latter case although enclosed by the same outer leaves as the stem they nevertheless belong to an inner tuft of leaves which arises from a separate point of the axis.

Some plants show no indications of these radical flowers and are then with difficulty separable from *S. angustifolium*. The plant appears to need comparison with no other species than this. It differs in narrower mostly smooth-edged leaves and stem, smaller and narrower spathes, less developed inner bract, shorter pedicels and larger more globose or pyriform paler capsules, often transversely corrugate. The thickened roots are a further noteworthy character. The few flowers seen are rather smaller than those of *S. angustifolium*, the divisions of the perianth less rounded at the apex and more distinctly aristulate, the yellow eye also appears to be larger.

In some specimens the basal and terminal capsules are of about equal age; others show at the same time basal capsules nearly mature, and upper spathes still tightly enclosing their flower buds. The successive opening of the flowers appears to be remarkably prolonged or irregular for several spathes which bear nearly mature capsules also enclose very immature flower buds.

Mounted on several sheets among fruiting specimens are a few plants just in flower which are larger, stouter and broader leaved with longer pedicels; these are apparently not distinguishable from *S. angustifolium* and may be referable to that species. They are, however, of the same bright, pale-green hue of *S. heterocarpum*, with smooth-edged stems, and their time of first-flowering, August, is hard to reconcile with what is known of the flowering period of *S. angustifolium*. A few of the specimens of *S. heterocarpum* show some stems stouter than the others and somewhat approaching these. Evidently the plant in all its phases cannot be fully understood from present material and its exact relationship to *S. angustifolium* must remain a subject for future study.

The Publications of the Department of Botany, Columbia University, consist of Memoirs in quarto and Contributions in octavo.

The Memoirs already published are:—

Vol. I. **Small.** A monograph of the North American species of the genus *Polygonum.* pp. 178. 84 plates. 1895. Price, six dollars.

Vol. II. **Rydberg.** A monograph of the North American Potentilleæ. pp. 224. 112 plates. 1898. Price, six dollars.

The Contributions have now reached the seventh volume.

Vol. I. Nos. 1–25 (1886–1892). Out of print, except Nos. 6, 7, 11, 17, 20, 21, 22, 24. These can be supplied at twenty-five cents each, except No. 6, which is one dollar.

Vol. II. Nos. 26–50 (1892–1894). Nos. 26, 28, 29, 32, 33, 34, 36 39 and 48 are out of print. Other numbers can be supplied at twenty-five cents each, except No. 35, which is one dollar and a half.

Vol. III. Nos. 51–75 (1894–1895). Nos. 52, 54, 60 and 72 are out of print. Others can be supplied at twenty-five cents each.

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No 160

CONTRIBUTIONS TO A BETTER KNOWLEDGE OF THE PYRENOMYCETES—I: A STUDY OF MISCELLANEOUS SPECIES

BY DAVID GRIFFITHS

NEW YORK
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Contributions to a better Knowledge of the Pyrenomycetes—I: A Study of Miscellaneous Species.

BY DAVID GRIFFITHS

(WITH PLATES 365, 366)

The following paper results from a study of a portion of my recent collections in this interesting group of fungi, and consists mainly of species from the Northwest, where the greater part of my collecting has been done. Of the species discussed *Trematosphaera caryophaga* alone was collected east of South Dakota. The other species were either collected in South Dakota, Wyoming, or Montana, or cultivated upon herbage which was obtained from these states.

During my investigations several species have been cultivated which are not recorded here, because of their extreme peculiarity and consequent necessity of obtaining more information regarding them. Some very peculiar modifications have been found in species of the genus *Pleospora*, developed under artificial conditions. In one instance a small quantity of an evident species of this genus developed perfectly superficial perithecia having radiating septate appendages, the whole having much the appearance externally of a perithecium of *Erysibe*. I find that some species of this genus develop very satisfactorily at times after being dried for several months. One immature species collected on dead culms of *Poa Nevadensis* in the Big Horn Mountains in August, 1898, grew nicely on being placed in a moist chamber for a few weeks in March and April, 1899. If some method of inducing more of the *Pyrenomycetes* to become mature could be devised it would be a boon to the collector, for, if the experience of others in the least resembles mine they find about one half of their collections in this group either sterile or immature.

The species of *Sordaria* recorded here are of special interest for several reasons. So far as I am aware, four of them have not been recorded before for this country. If once found they can be cultivated very easily and made use of by the teacher in demonstrations. I know from experience that it is difficult for the young student to form a clear conception of how the asci and spores look within the perithecium although he actually sees them escape from it when it ruptures under the cover glass. With a good condenser one can make out the shape of the asci in these species quite well without rupturing the perithecium at all. This is especially true of such a polysporous form as *S. curvicolla.* I have in several instances been able to secure the perithecia of this species, before they were yet mature, showing one or two large asci protruding above the other younger ones, and having mature spores, while the others had only very young and imperfectly outlined ones within them. As the younger asci develop, the older ones rupture, and their spores escape through the ostiolum, forming a black globule on the top of the perithecium. This is also true, to a less degree, of the two species of *Melanospora.*

Melanospora Poae sp. nov.

Perithecia scattered or gregarious, superficial, thin, membranous, white turning to black and opaque, prolonged above into a curved or twisted beak once to twice the length of the perithecium, covered with long delicate flexuous sparingly septate hairs, 140–180 $\mu \times$ 500–600 μ: asci broadly clavate, short stipitate, evanescent, without paraphyses, 10–13 $\mu \times$ 26–30 μ: spores very variable, oblong or cuboidal with an apical grove and often flattened parallel to it, 4.5–5 $\mu \times$ 5.5–6.5 μ. *Pl. 336. f. 24–26.*

This species has been cultivated on dead culms and leaves of *Poa Nevadensis* collected in the Big Horn Mts., near Buffalo, Wyo., Aug., 1898 (Williams and Griffiths). The culms and leaves were thoroughly moistened and placed in a moist chamber on the 14th of March. Mature perithecia were found on the 29th of the same month—a remarkably short time for the development of this class of fungi. In order to make certain that the perithecia were not already partly developed before the material was placed in the moist chamber, two other cultures were made in April. This time the material was carefully examined, moistened and placed on sterilized filter paper in a Petri dish. Quite a growth of mycelium extended from the culms and leaves over the paper, and the perithecia were again developed entirely distinct from the dead herbage. In neither culture have I been able to find conidia.

There are plenty of Hyphomycetous conidia, especially those of *Cladosporium* and *Alternaria*, but no connection has been traced with any conidial form found on the herbage used. Attempts have been made to germinate the ascospores without success. It is hoped that they will grow later in the season and that pure cultures can then be made.

Melanospora Townei sp. nov.

Perithecia superficial, scattered, thin, membranous, transparent, globular, covered uniformly with long straight or slightly wavy irregularly outlined hairs and surmounted by a cylindrical beak which terminates in a loose aggregation of straight or slightly wavy hairs of unequal length, white turning to light transparent umber and finally black, 225–300 μ in diameter; beak about equal to the diameter of the perithecium and 60 μ in cross-section: asci very evanescent, broadly clavate to obovate, short-stipitate, 8-spored, 30–40 μ × 60–75 μ: spores crowded, olivaceous, becoming dark and opaque, elliptical, 15–17 μ × 20–25 μ; the slightly projecting truncate apices, when viewed endwise, are seen to have a relatively large hyaline pore in the flat truncate ends. *Pl. 365. f. 19–22.*

At my request, Mr. J. R. Towne, of Aberdeen, S. D., sent me fresh material of *Salsola kali tragus* which was affected with various species of *Hyphomycetes*. This material reached me on the 19th of March, when it was placed immediately in a damp chamber and kept thoroughly moistened until the first of June. On the 9th of May the beautiful white perithecia of the above species appeared in abundance.

In about three days after the material was placed in culture there occurred a very luxuriant growth of a species of *Alternaria*. This completely covered the twigs with a dense black layer of spores and hyphae which promised to choke out anything else that might develop. About the 1st of May this ceased to grow and all of the twigs were then covered with a layer of dormant *Alternaria* spores. When the perithecia appeared they were produced perfectly superficial and loose on the top of these masses of spores. I was unable to trace any connection between them and any conidia or distinct mycelium, although some of them grew on the surface of the glass in close proximity to the twigs. All attempts to germinate these ascospores have thus far proved futile.

This species resembles *M. leucotricha* Cda. very much outwardly, except that the perithecia are less hairy and the ostiolum less fimbriated. The spores and asci are, however, decidedly different although about equal in size. Specimens from Rehm's Ascomycetes have slightly inequilateral spores with acute hyaline apiculi. I have not been able to find asci with mature spores in my specimens, but they are common in the European ones. The illustration of the ascus in this paper was made from one in which the spores were just beginning to change color, because of my inability to get the asci with perfectly mature spores out of the perithecia without rupturing them. In fact the asci of this species are much like those of *Sordaria curvicolla* as regards persistency. I have often found immature asci in perithecia which had a globular mass of mature spores on the ostiolum, showing that there is a succession of development correlated, I judge, with the large size of the fully formed asci as compared with that of the perithecium. Some of the asci become mature, rupture, and allow their spores to escape, thereby giving room for other younger asci to develop.

SORDARIA MINUTA Fckl.

Perithecia superficial, scattered, thin, membranous, white to fuscous, and so transparent that the spore-bearing area which occupies rather less than half the length of the perithecium can be readily distinguished, covered with short septate agglutinated hairs which are more prominent around the smooth, black, naked, conical, erect or curved apex, 140–180 μ × 36c–510 μ: asci paraphyseate, cylindrical, with a contracted stipe one half the length of spore-bearing portion, 4-spored, 15–18 μ × 100–110 μ: spores monoseriate, elliptical, acutely pointed, olivaceous to black and opaque when mature, 13–14 μ × 16–22 μ, terminating below in a hyaline straight or slightly curved gelatinous appendage one half the length of the spore. *Pl. 365. f. 10–12.*

The asci are without exception 4-spored and uniseriate. Dr. Winter (Die deutschen Sordarien, Abhand. der Naturforsch. Gesell. zu Halle, **13**: 67–107. 1887) characterizes this species as having 4- or 8-spored asci. But he also finds in many of his collections and cultures of German specimens that one or the other form is quite constant, while in still other material the two forms are mixed.

Dead culms and leaves of *Poa Nevadensis* having on them imperfectly developed perithecia of some of the *Sphaeriales*, probably a *Pleospora*, were collected in the Big Horn Mts., near Buffalo, Wyo., at an altitude of about 8000 ft. in August, 1898 (Williams and Griffiths). On the 14th of April, 1899, this material was thoroughly soaked and placed in a moist chamber. On the 3d of May mature perithecia of the above were present in considerable numbers. They continued to develop for two weeks longer when the material became dry. No precautions were taken regarding heat and moisture, the culms and leaves being cut into appropriate lengths to fit in an ordinary 3 ½-inch Petri dish, thoroughly moistened, and kept at laboratory temperature of about 21° in another Petri dish of larger size.

SORDARIA CURVULA DeB.

Perithecia scattered, superficial but firmly attached by the base, conical, truncate, curved and blackened at the apex, thin, membranous, sparingly covered with septate fasciculated hairs which are more prominent around the base of the blackened apex, 275–375 μ x 500–700 μ, spore-bearing area easily distinguished by transmitted light, asci paraphyseate, cylindrical-clavate, stipitate, 8-spored, 25–35 μ x 160–200 μ: spores biseriate with the two lower spores of the upper series overlapping the two upper spores of the lower series in the center of the spore-bearing portion of the ascus, oval, 19–21 μ x 24–28 μ, abruptly but acutely pointed, olivaceous to black with a gelatinous hyaline appendage at the lower end varying from one half to once the length of the spore. *Pl. 365. f. 1–5.*

This differs in several particulars from *S. curvula aloides* Wint. as recorded for this country by Messrs. Ellis & Everhart in N. A. Pyreno. 129, and corresponds more closely with the typical European species. The main differences occur in the characteristics of the hairs and the serial character of the spores. When the asci escape from the perithecium under the microscope they often appear distorted, becoming inflated so as to render the ascus more or less oval in outline, but leaving the arrangement of the spores undisturbed. I have had this phenomenon occur in water, 2 % chrome-alum, and 5 % caustic potash. Dr. Winter describes and figures a similar phenomenon in his specimens.

Dead stems of *Salsola kali tragus* affected with a species of *Ophiobolus* were collected at Aberdeen, S. D., in March, 1898. On the

10th of March, 1899, these stems were placed in a moist chamber under conditions similar to those described above for *Poa Nevadensis.* Mature perithecia of this species were first observed on April 7th. Subsequent cultures from the same material show the perithecia to develop in about three weeks. It appears to thrive best in an abundance of moisture. I have succeeded in getting the best growth of it when the herbage was not only thoroughly moist but when the chamber in which they were placed had water standing in the bottom of it. This species has also been cultivated in small quantity on dead scapes and leaves of *Allium* from the Big Horn Mountains of Wyoming, treated in the same way.

SORDARIA CURVICOLLA Wint.

Perithecia scattered, semi-immersed, pyriform, thin, membranaceous, about 600 μ in diameter, outline of asci plainly distinguishable by transmitted light, the conical truncate black apex clothed with short, delicate, simple, brown hairs, asci broadly clavate, polysporous with few evanescent paraphyses, 100–120 μ × 270–300 μ: spores oval, 10–11 × 14–15 μ, olivaceous to dark and opaque with a hyaline appendage at the lower end about ⅔ the length of the spore. *Pl. 365. f. 13–15.*

This species developed on *Salsola kali tragus* with *Sordaria curvula*, but I found none of it for about five weeks after the culture was started.

This differs from European specimens principally in the larger number of spores and their occasionally darkened apiculi. The latter is not invariable in my specimens and I apprehend that the former may be very variable in the species. Dr. Winter, after isolating an ascus in one of his specimens and rupturing it, counted 128 spores, but my specimens contain as many as 150 spores, a variation which I consider of minor importance. In other respects my specimens correspond very well with European specimens in Krieger's Fungi Saxonici, no. 33, as they do also with Dr. Winter's descriptions and figures.

I would not be surprised to know that this and the two previously described species are very common in this country although they have not been recorded before so far as I am aware. They are very liable to be overlooked by the collector. Indeed, it is with difficulty that I am able to find the perithecia in my cultures after they have become dry, although they are very numerous.

SORDARIA PLEIOSPORA Wint.

Perithecia scattered, with base slightly sunken in the soft substratum, covered especially above with the characteristic cellular agglutinated hairs of this group, together with a few long, delicate, simple, slightly flexuous, sparingly septate, brown hairs, and terminating in a curved, black, rounded or truncate beak, 450 $\mu \times$ 600 μ: asci 28–32-spored, cylindrical-clavate, short-stipitate, 30–40 $\mu \times$ 175–200 μ: spores oval, 12–15 $\mu \times$ 18–21 μ, black and opaque with hyaline evanescent gelatinous appendage at lower end, about ⅔ the length of the spore. *Pl. 365. f. 6–9.*

The measurements of spores and asci given above are considerably at variance with the published descriptions of European forms. The species is also described with gelatinous apiculus at each end of the spore. The number of spores in an ascus is said to vary from 16–64, but my specimens vary within the much narrower limits quoted above. The gravest variations, therefore, are in spore measurements which are given by Winter as 16–19 $\mu \times$ 24–34 μ. The variation in the size of the ascus is not so important in my estimation since the number of spores is so variable.

Associated with these species developed on *Salsola* stems I find an abundance of conidial forms resembling those which Winter found in his cultures. He, however, was unable to trace any connection between these conidial forms and the species of *Sordaria* with which it was associated and simply mentions it as a probable conidial form. He describes the hyphae as short, hyaline, continuous, with a bifurcate apex; and the spores as fusiform with attenuate base and rounded apex, continuous or obscurely uniseptate. In my material the spores are of two distinct forms both of which are evidently polyseptate. One form resembles those described above in everything but the septation of the spores while the other has long spindle-form spores resembling the former but pointed at both ends. Thus far I have found nothing that enables me to make any statement regarding their probable affinities.

SORDARIA FIMICOLA (Rob.) Ces. & DeNot.

This species developed on dead *Eleocharis* culms affected with *Pleospora aquatica* placed in moist chamber for 18 days. As it is described by Messrs. Ellis & Everhart in N. A. Pyreno., 127, it need only be mentioned here. *Pl. 365. f. 16–18.*

PERISPORIUM VULGARE Cda.

Perithecia superficial, scattered or gregarious and more or less angular from mutual compression, subglobose, carbonaceous, brittle, black and shining when mature, covered at first with a white tomentum which soon disappears, about ⅓ mm. in diameter: asci evanescent, broadly clavate, long-stipitate, 8-spored, 15–20 μ × 90–105 μ: spores 4-celled, 6–8 μ × 24–28 μ, brown, opaque, with the two end cells subconical and the two middle ones oblong-cubical, easily separating into separate cells. *Pl. 366. f. 15–18.*

This species is described and figured here for several reasons So far as I am aware, it has not been recorded before from this country, although figured and described by Messrs. Ellis & Everhart from European specimens. The specimens, which I have in good quantity, were collected by Mr. C. W. Williams, one of my former students, at Aberdeen, S. D., on sticks and straw in an old rubbish heap, March, 1898.

The ascospores germinate very readily and grow vigorously. The specimens from which the accompanying figures were made were cultivated from the ascospores of the material cited above. Ordinary filter paper was sterilized, placed in a Petri dish and moistened with a sterile decoction of ash leaves, and then inoculated with the ascospores. A delicate white mycelium was produced in abundance in a very few days, but careful search failed to discover any conidia. The perithecia became mature in six weeks. The spores (cells of ascospores) apparently have no regular method of germination, like those of the *Sordariaceae* or *Chaetomiaceae* for instance, but crack open irregularly to allow the promycelium to develop. Although the conditions were apparently favorable for mycelial development the perithecia were few and scattering in my cultures.

Pocosphaeria Allii sp. nov.

Conidial hyphae arising from a much branched torulous, knotted, brown, subepidermal mycelium, variously bent and knotted, 6–8 μ × 150–200 μ: conidia oval, 1–3-septate, brown, minutely echinulate, 11–14 μ × 24–30 μ: perithecia subglobose to hemispherical, 100–125 μ in diameter, erumpent, membranous, dark-colored with a thickened darker ring around the ostiolum; bristles around the thickened ostiolum black, smooth, straight to recurved: asci cylindrical, contracted below, sessile, usually more or less curved or inequilateral, 12–15 $\mu \times$ 50–60 μ: spores 3-septate, constricted at the septa, fusiform, brown, 5–8 $\mu \times$ 16–20 μ. *Pl. 366. f. 1–9.*

On dead scapes and leaves of *Allium brevistylum* in Big Horn Mts., near Buffalo, Wyo., Aug., 1898. (Williams and Griffiths.)

The method of development of the perithecia in this species is of interest. The conidial hyphae usually protrude through the stomata in tufts of 2–5, and the perithecia are developed as a proliferation of the cells at their bases. At first the hyphae arise directly from the hypodermal mycelium which can be easily seen in tangential sections, but the proliferation of cells at their bases soon gives them the appearance of arising from a pseudo-parenchymatous mass of fungous cells. The hyphae are carried upward by this mass of cells, and the stoma and surrounding tissues become much distorted. The hyphae appear to produce conidia for some time after the beginning of perithecial development as shown in the figures. These, however, finally disappear before the perithecium becomes mature, and bristles develop surrounding the central ostiolum. Unfortunately mature material is rather rare, but the conidial and transitional stages have been collected in good quantity.

Pyrenophora Salsolae sp. nov.

Perithecia aggregated, subepidermal, early erumpent, subglobose to flattened, black, carbonaceous, brittle, about 300 μ in diameter, covered uniformly above with short, brown to black, septate, slightly wavy fugaceous bristles: asci cylindrical, contracted below into a short-stipitate base, 3–8-spored: spores one- or two-seriate, ovate, muriform, 4–5-septate with two longitudinal septa, slightly flattened, yellow, 6–11 $\mu \times$ 20–26 μ. *Pl. 366. f. 30–34.*

The method of spore dissemination in this species is very interesting. There is near the middle of the ascus a transverse marking which is usually plainly visible. Sometimes it is simply a transverse line on the ascus wall, but more often it appears as a spiral of 1½ turns. When pressure is put upon the cover glass, the asci rupture on these markings, the top of the ascus shooting out for some distance, leaving in its wake the spores more or less deranged, but always in a long string imbedded in a gelatinous matrix, which does not remain attached to them when they are isolated. Often one may find in the field the top and bottom of an ascus separated by twice its original length, and the two parts connected by a string of spores imbedded in their matrix. The rupture of the ascus is brought about doubtless here as in many other ascomycetes by the tension within it, for the gelatinous material with its contained spores occupies two or three times its original volume when set free by the rupturing of the ascus.

This was cultivated on dead stems of *Salsola kali tragus* with the species of *Sordaria* described above. It developed in rather small quantity in eight weeks' time.

Trematosphaera caryophaga (Schw.)

Perithecia superficial with their bases slightly sunken in the thin, black, carbonaceous crust which covers the nut more or less uniformly, rough, black, carbonaceous, brittle, hemispherical, with papilliform ostiolum, 350 μ in diameter, asci evanescent, subcylindrical with filiform paraphyses, 10–12 μ × 55–75 μ: spores biseriate, oblong, narrowed and round at the ends, slightly inequilateral or curved, 3-septate with a darkened band surrounding the middle septum, 4–6 μ × 10–16 μ. *Pl. 366. f. 12–14.*

This species described by Schweinitz, Syn. N. Am. Fungi, no. 1594 Trans. Amer. Phil. Soc. Phila., 215, 1831, has been included by Messrs. Ellis and Everhart, North American Pyreno. 207, with *T. nuclearia* (DeNot) Sacc., published in Micr. Ital. **9**: 462, *f. 4*; but a very little study of the specimens from different localities is necessary to convince one that the American form growing on decaying shells of hickory nuts, is very different from the European form growing on olive pits. Had I but one specimen I might consider the species variable enough to produce the differences which are observable; but the Pennsylvania specimens collected by Mr. Everhart and my own collected in the burrow of some rodent at Fort Lee, New Jersey, are remarkably constant in all their characters, even to the coloration of the spores. The main differences are those of size which are brought out in my figures (10 and 11, *pl. 366*) of these two species. The European species is larger throughout than the American—the perithecia measuring about 525 μ, the spores 6–8 μ × 18–21 μ. I have been unable to get out complete asci from the European specimens at hand (Roumeguère Fungi Selecti Gallici, no. 4783). The coloration of the spores differs markedly also. In the European specimens the spores are darker in color and the central band extends over all of the two central cells, while in the American ones there is a light streak between the dark band and the outside septa. The paraphyses are much less abundant in the European species.

In both species the dark band obscures the middle septum so that it is often difficult to determine whether the spores are really 3-septate or not. I find, however, that after soaking in glycerine for some time the central septum becomes more apparent. Its presence is sometimes indicated by a very slight constriction; in young spores it can be very distinctly seen.

Dothidea conspicua sp. nov.

Stroma immersed, irrumpent, surrounded by the lacerated remains of the ruptured epidermis, circular or oval, seldom confluent, flat, rough, black, ⅓–⅔ mm. in diameter: ascigerous cavities sunken, oval to conical and more or less angular from mutual compression, 50–60 μ x 100 μ: asci cylindrical-clavate, with a short, stout, blunt stipe, without paraphyses, 65–85 μ x 12–14 μ: spores sub-biseriate, unequally uniseptate, constricted, at first yellow, but finally dark and opaque, 5–6 μ x 13–18 μ. *Pl. 366. f. 19–23.*

On *Yucca angustifolia* at Billings, Mont., August, 1898. (Williams & Griffiths.)

Mr. J. B. Ellis described a *Phyllachora ? Yuccae* on *Yucca angustifolia* (Bull. Torr. Bot. Club, **22**: 440. 1895) collected by Dr. Egeling at Matamoras, Mexico. I thought at first that my specimen must be the fully developed condition of the immature species which he there describes; but the characteristics of the stroma alone are enough to separate it from the Mexican specimen, which also appears to me to be a *Dothidea.* The absence of paraphyses and the method in which the epidermis becomes ruptured and lacerated are also good characteristics which would separate the above described species from that described by Mr. Ellis. The nearest relative, however, of this species appears to be *Didymosphaeria yuccaegena* (Cke.) Sacc., Sylloge Fungorum, **1**: 708. This was originally described as *Sphaeria yuccaegena* Cooke, in Grevillea, **7**: 12. 1878, from specimens collected by Dr. Harkness on *Yucca communis,* at Sacramento, California. After the change in name made by Saccardo, cited above, Cooke in

Grevillea **18**: 28 wrote the species as *Didymosphaerella yuccogena* Cke. This species also may be a *Dothidea*. It certainly appears to have its asci produced in stromatic cavities without perithecia the same as the species here described; and the spores have the typical unequal septation of the genus *Dothidea* when young, but they become more nearly equal when mature. In the general appearance of asci and spores there is but little difference between this species and the one which is described above. A specimen in the Ellis Herbarium from Dr. Harkness shows the spores to be larger and the asci nearly twice the width at the base. These are the only differences in the microscopic characters. The method of growth is, however, decidedly different. The stromatic areas in my species are two to three times as large, prominently erumpent and surrounded by the lacerated remains of the ruptured epidermis; while in the other case the epidermis is unruptured although the specimens appear to be as fully developed as mine.

Pleospora aquatica sp. nov.

Perithecia scattered, subglobose to hemispherical, 140–180 μ in diameter, flattened when dry, subepidermal, remaining covered, membranous, black and smooth with flat indistinct ostiolum: asci cylindrical-clavate, curved, and often bent into a u shape, short-stipitate, without paraphyses, 22–29 μ × 95–125 μ: spores oval, 10–12 μ × 28–30 μ, slightly flattened, with 5 transverse and 2 to 4 longitudinal septa, constricted at all transverse septa and surrounded by a gelatinous hyaline covering which is prolonged into a short thick blunt appendage at either end. *Pl. 366. f. 27–29.*

This species was collected at Aberdeen, S. D., in May, 1896, on dead stems of *Eleocharis palustris* under water. The pond in which the collection was made, had been filled with artesian well water together with that obtained from natural drainage to a depth of not less than a foot since the previous season. I first discovered the fungus in April when it was immature. About a month later I visited the same locality again and found an abundance of it in the best condition possible. The pond contained from 2 to 2½ feet of water during the spring months and the culms of the previous year upon which the fungus grew were entirely submerged.

COLUMBIA UNIVERSITY, 1 July, 1899.

Explanation of Plate 365

1–3. *Sordaria curvula* DeB. Perithecium, ascus and spore.

4 and 5. *Sordaria curvula* DeB. Two germinating spores after 24 hours in water.

6–8. *Sordaria pleiospora* Wint. Perithecium, ascus and spore. Spores in ascus slightly deranged.

9. Hair from perithecium of *S. pleospora.*

10–12. *Sordaria minuta* Fckl. Perithecium, ascus and spore.

13–15. *Sordaria curvicolla* Wint. Perithecium, ascus and spore.

16–18. *Sordaria fimicola* (Rob.) Ces. & DeNot. Perithecium, ascus and spore.

19–21. *Melanospora Townei* sp. nov. Perithecium, ascus and spore.

22. Hair from perithecium of *M. Townei.*

NOTE.—All perithecia × 35, asci 230, and spores 315. Figs. 4 and 5 × 230; 9 and 22 × 315.

Explanation of Plate 366

1–9. *Pocosphaeria Allii* sp. nov.

1. Mature perithecia, × 50.

2. Young perithecium crowned with the conidial hyphae, × 230.

3. Conidial hyphae showing a slight proliferation of cells at their bases, × 230.

4. A single hypha projecting through a stoma, × 230.

5. Ascus, × 230.

6. Spore, × 315.

7. Conidiospores, × 315.

8 and 9. Mycelium as seen through the transparent epidermis, × 230.

10 and 11. *Trematosphaera nucleiara* (DeNot.) Sacc. from Roumeguère Fungi Selecti Gallici, no. 4783.

10. Perithecium, × 35. 11. Spores, × 315.

12–14. *Trematosphaera caryophaga* (Schw.).

12. Perithecium, × 35. 13. Ascus, × 230. 14. Spores, × 315.

15–18. *Perisporium vulgare* Cda.

15. Perithecium grown on paper in Petri dish, × 75.

16. Ascus, × 230. 17. Spores, × 315. 18. A single cell of ascospore after 24 hours' growth in water.

19–23. *Dothidea conspicua* sp. nov.

19. Portion of affected *Yucca* leaf, × 12. 20. Ascus, × 315.

21. Portion of a stoma, × 35. 22. Spore, × 315. 23. A stromatic cavity showing cellular structure, × 230.

24–26. *Melanospora Poae* sp. nov.

24. Perithecium, × 50. 25. Ascus, × 315. 28. Spores, × 480.

27–29. *Pleospora aquatica* sp. nov.

27. Perithecium, × 35. 28. Ascus, × 230. 29. Spores, × 315.

30–34. *Pyrenophora Salsolae* sp. nov.

30. Perithecium, × 35. 31. Two asci, one of which shows the spiral line of dehiscence. 32. An ascus slightly extended after rupturing. 33. Two asci, one of which shows a straight line of dehiscence. All × 230. 34. Spores, × 315.

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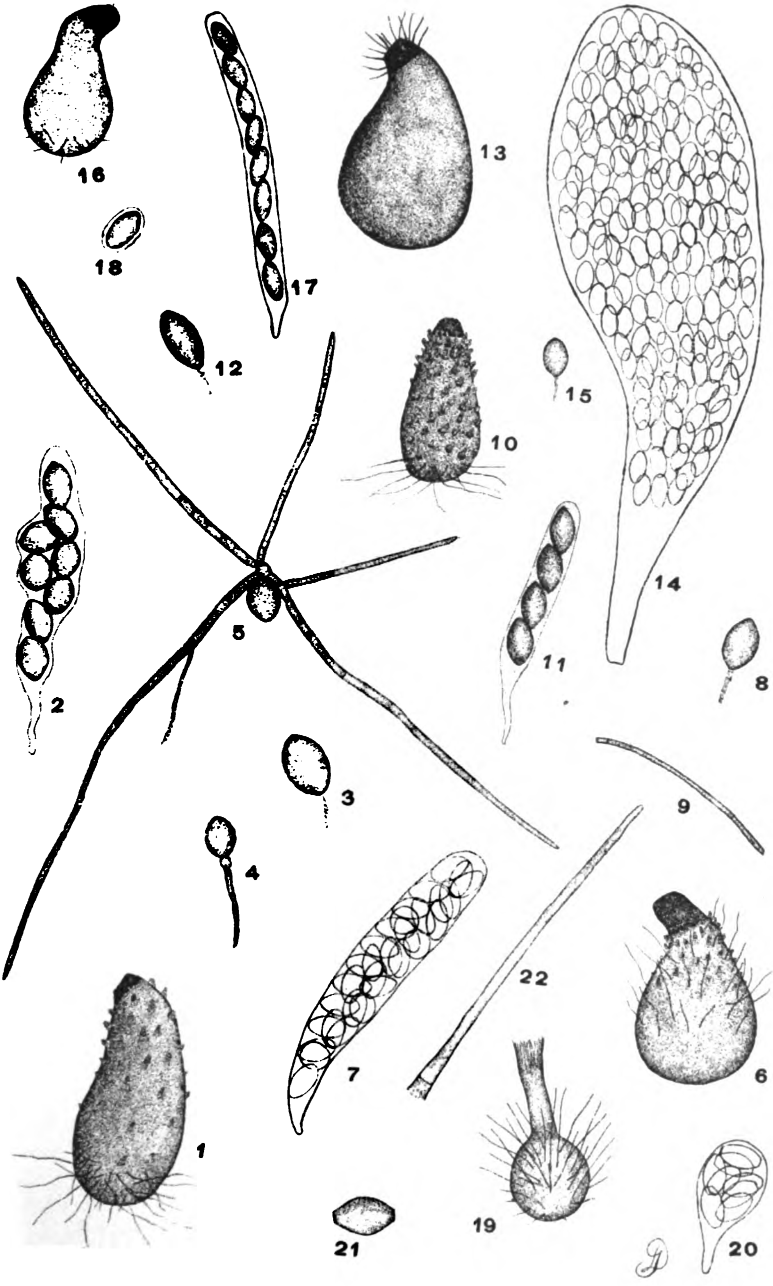

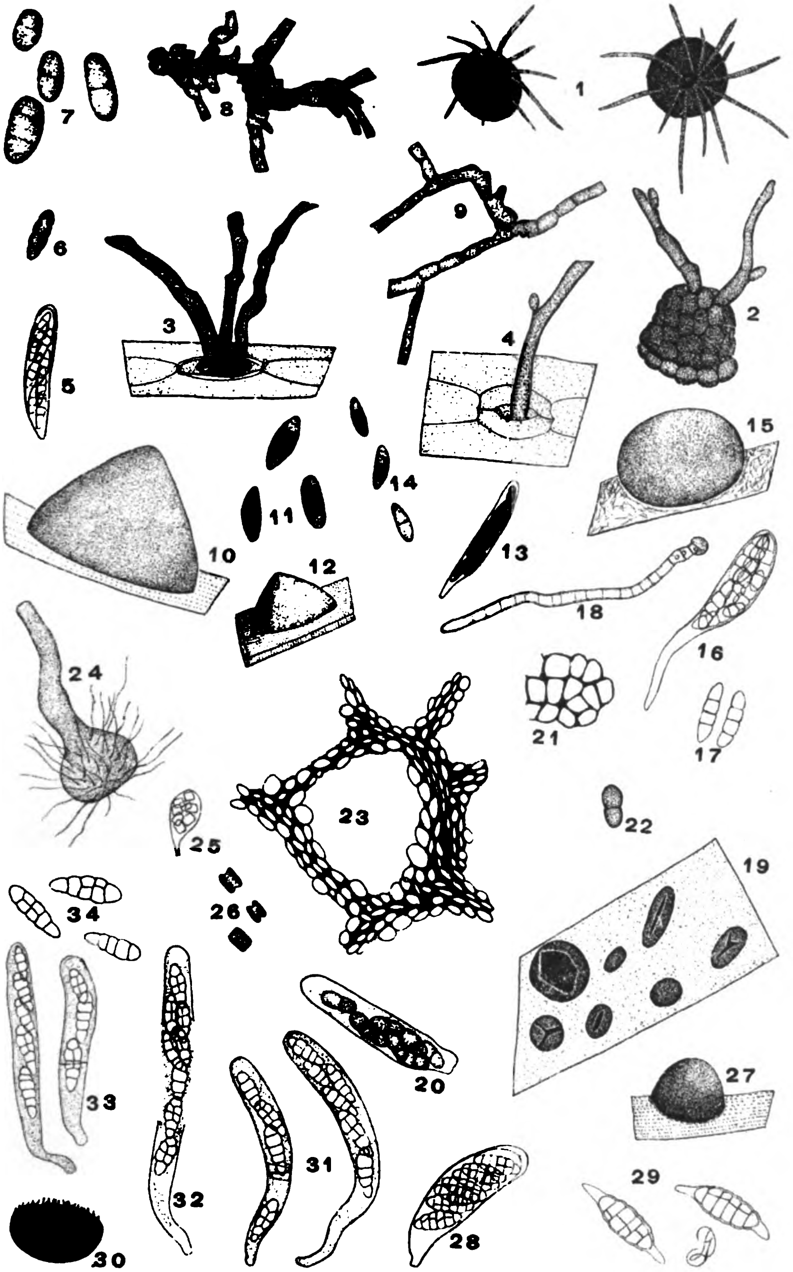

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STUDIES IN SISYRINCHIUM—IV:
S. ANGUSTIFOLIUM AND RELATED SPECIES OF THE WEST AND NORTHWEST

BY EUGENE P. BICKNELL

NEW YORK
1899

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Studies in Sisyrinchium—IV: S. angustifolium and related Species of the West and Northwest

By Eugene P. Bicknell

The simple-stemmed blue-flowered *Sisyrinchia* of the far west and northwest which have hitherto been referred mostly to *S. angustifolium* Miller in reality represent a group of distinct species. This appears unmistakably from a considerable collection of specimens brought together from various sources; but it is further evident from this same material that, largely by reason of its general deficiency in specimens with mature fruit, it forms a wholly inadequate basis for the confident segregation of the various forms.

The problem presented therefore is the reduction of this inchoate mass into some approach to natural order under conditions which make impossible a final and satisfactory result. In order to take any forward step in these circumstances it is necessary to proceed in great part on the individual judgment pending the final proof which a sufficient series of specimens can alone afford. Under the risk of error involved in thus attempting the disentanglement of the species, I have aimed rather to avoid the creation of any mere synonym than to define the exact nature of the differences between the forms recognized, whether varietal or fully specific. And a number of forms have been passed over entirely as appearing to have too uncertain claims to possible specific rank.

Sisyrinchium Idahoense sp. nov.

From 20–45 cm. high, pale green and glaucous, usually showing some discoloration in drying. Leaves from half to three quarters the height of the stem, grass-like, varying from thin and somewhat lax to firm and closely erect, and from 1–3.5 mm. in width, attenuate to somewhat abruptly acute, the edges serrulate or smooth: stem straight and erect or somewhat flexuously curved, frequently twisted, simple or occasionally bearing a leaf near the top subtending one or two short branches, 1–3 mm. wide, winged, the edges sometimes smooth but usually distinctly serrulate, or even hispidulous-aculeolate: spathes often deflected, green or faintly purplish, long and relatively narrow, the keels of one or both bracts often serrulate or hispidulous; outer bract 3–6 cm. long, commonly ¼–⅓ longer than the inner one, rarely twice its length, foliaceous and abruptly pointed or more slender and attenuate, the margins below narrowly hyaline, united for about 4 mm. at base; inner bract 2–3.5 cm. long, herbaceous, the margins narrowly hyaline, obtusely pointed or acute; interior scales mostly about ¾ the length of the inner bract; the spathes, when borne on branches, are shorter with less prolonged outer bract than when terminating the main stem: flowers 3–6 on erect pedicels 1.5–3 cm. long, deep violet-blue, with rather small yellow eye, large, perianth 12–18 mm. long, indicating an extreme spread of over 3.5 cm.; stamineal column 5–8 mm. high; ovary glandular puberulent: capsules globose or ovoid, 4–6 mm. high, rather thick-walled, turning dark; seeds (immature) irregularly obovoid, angled, rugulose, stipitate, about 1 mm. in longer diameter.

Idaho, Washington, Oregon and California. Meadows and moist grassy places, flowering in northern Idaho from the middle of May into July, in western Oregon about a month earlier.

Idaho: Kootenai Co., J. B. Leiberg, Geo. B. Aiton; Latah Co., L. F. Henderson; Nez Perces Co., J. H. Sandberg.

Washington: Whitman Co., A. D. E. Elmer, C. V. Piper; Chehalis Co., A. A. & E. Gertrude Heller.

Oregon: "Eastern Oregon," L. F. Henderson; Crook Co., J. B. Leiberg; Benton Co., A. Isabel Mulford.

California: Mt. Shasta, 6000 ft. alt., Geo. Engelmann; Yosemite Valley, H. Mann.

I find the labels on specimens of this plant variously inscribed with the names, *S. angustifolium*, *S. anceps*, *S. mucronatum* and *S. bellum*. On one sheet all four names appear in different handwritings, well illustrating the confusion that has prevailed in regard to the plant.

The species may be taken as the northwestern representative of *S. angustifolium* to which it is nearly related, differing in its typical state mainly in more ciliolate-serrulate stems, longer spathes with less unequal, more foliaceous bracts and much larger flowers; it is also, as a rule, less stiff and straight, the stems often somewhat curved; the spathes frequently deflected and enclosing longer membranous scales than in *S. angustifolium*. In the usual state of the latter the wings of the stem are manifestly widened into the base of the spathe; in *S. Idahoense* they are scarcely, if at all, so widened, but may be even slightly narrowed conformably with a joint-like transverse constriction where the raised line of the stem disappears as if pinched out below the base of the spathe. Suggestions of this character casually appear in *S. angustifolium* in which, however, as a rule, the raised line of the stem passes uninterruptedly into the stiff erect spathe.

Stouter, broader-leaved forms of *S. Idahoense* appear somewhat intermediate in aspect between *S. angustifolium* and *S. littorale* Greene, of Alaska. From the latter, however, the species differs essentially in its larger flowers and smaller fruit; it is also less stout, paler and more glaucous, with narrower leaves of thicker texture and less foliaceous and differently shaped inner bract.

The type specimens from northern Idaho, Nez Perces Co., have rather long and broad thin leaves, long foliaceous bracts and very large flowers. The capsules are 4–6 mm. high, and mostly obovate-subglobose often contracted to a substipitate base. Most specimens from Idaho and some from Washington agree closely with these, although other specimens are much slenderer and with smaller flowers. Some specimens from Oregon and Washington, somewhat doubtfully referred here, bear two peduncled spathes and have stiffer leaves, shorter often purplish spathes, apparently smaller flowers and rather larger more globose fruit on slightly more exserted pedicels. Other specimens, from western Oregon are noteworthy from having dried uniformly dark and for their long often flexuous and branched stems, and rather small somewhat obovate fruit. The specimens cited from California are both in poor condition, and though appearing somewhat aberrant are certainly nearer to *S. Idahoense* than to any other species now known.

Sisyrinchium occidentale sp. nov.

Mostly over 20 cm. high (15–35 cm.), stiff and erect, glaucescent to pale glaucous green, usually with a yellowish tinge, discoloring slightly in drying; roots clustered, usually coarsely fibrous. Leaves 1–2.5 mm. wide, firm and erect or sometimes thinnish, strongly or rather weakly close-nerved, very acute, the extreme tip often hardened in age, the basal remains of older leaves frequently becoming bleached and silvery: stems stiffly erect, usually much longer than the leaves, 1–2 mm. wide, wing-margined, the wings usually closely few-striate, the edges like those of the leaves very smooth, a slight transverse constriction just below the spathe: spathes erect or slightly deflected, green or faintly dull purplish, the bracts often thin and rather weak-nerved, the outer one mostly straight, the inner one more or less convex in outline; outer bract surpassing the inner 2–15 mm., mostly 2–3 cm. long, attenuate-acute, hyaline-margined below and united-clasping for 2.5 mm. at base; inner bract rather broadly hyaline-margined nearly to the apex, sometimes acuminate but usually broad above and abruptly acute or even scarious obtuse; interior scales rather broad, often nearly equaling the inner bract: flowers 3–6, medium to large, deep violet-blue on erect exserted pedicels; perianth 10–14 mm. long; stamineal column 4–6 mm. high; capsules (not fully mature) subglobose, brown, about 4 mm. high, apparently rather few-seeded, and glabrate or nearly so at maturity.

Idaho and Nevada to Colorado and North Dakota, flowering in June and July.

Idaho: Arco, June 18, 1893, Dr. Edward Palmer; Pleasant Valley, June 25–30, 1891, G. N. Allen.

Nevada: Pleasant Valley, May, 1865.

Utah: Supply Creek, July 29, 1875, 9000 ft., L. F. Ward; Salt Lake Valley, July, 1888, J. H. Paul; Bear River Cañon, Aug., 1869, S. Watson.

Colorado: Hot Sulphur Springs, Middle Park, Aug. 1, 1881, Geo. Engelmann; Twin Lakes, July 6, 1896, Biltmore Herb.

Montana: West Gallatin River, June 9, 1883, F. Lamson-Scribner, no. 271, "moist banks"; Helena, June, 1888, F. D. Kelsey.

Wyoming: F. Tweedy; Yellowstone National Park, Mrs. Moore, 1894; Mammoth Hot Springs, 6000–7000 ft., June 4, 1894, F. H. Burglehaus; May, 1889, 6600 ft., F. W. Dewart; North Platte, "wet sandy bottom," July 25, 1858; Jackson's Hole on Snake River, June 18, 1860, F. V. Hayden, "gravelly bottoms. 6000 ft.;" Ft. Bridger, July, 1873, T. C. Porter.

A species resembling forms of *S. augustifolium* but evidently distinct, and probably not distantly related to *S. halophilum* but usually much stouter and taller and with much larger flowers. It differs from *S. angustifolium* mainly in much less elongated outer bract and larger interior scales, more narrowly winged stem, constricted below the frequently deflected spathes, larger flowers and apparently smaller fewer-seeded capsules. The material at hand, however, is inconclusive as to the exact character of the mature capsule and seeds.

Certain small specimens, imperfect as to flowers and fruit, appear somewhat intermediate with *S. halophilum*, but the fully developed states of the two plants show them to be distinct. From *S. halophilum* the present species differs in brighter green color, less thickened roots, broader leaves and stem, the latter more decidedly winged, larger spathes with more unequal and acute bracts, larger flowers on more slender pedicels, larger and darker glabrate capsules.

Several small specimens from the Mammoth Hot Springs with mostly curved stems, and leaves very variable in length and breadth are referred here with some hesitation. A single specimen from North Dakota is old and fragmentary but at present can be placed with no other species than this. In fact I am obliged to make this species for the present a repository for a somewhat ill-assorted series of specimens which may represent more than one species but which it is impossible to place satisfactorily wanting a better knowledge of their flowers and mature fruit.

Sisyrinchium segetum sp. nov.

Duller green and less glaucous than *S. occidentale*, even scarcely glaucescent, with narrower and thinner leaves and more numerous and narrower stems apparently growing close together in dense masses rather than tufted: leaves mostly setaceous and 1 mm. wide (.5–1.5 mm.), not very close-nerved except when young, sometimes roughish toward the tapering aculeate often bent apex: stems mostly 1 mm. or less wide, the narrow wings thin, with almost hyaline edges: spathes mostly purplish to red-purple, sometimes nearly green, stiffly erect, the outer bract very slenderly attenuate sometimes for fully half its length, tapering acute, 18–38 mm. long, subequal with the inner bract or surpassing it by 12 mm., or even more, the inner bract narrower, more slenderly attenuate and less hyaline-margined than in *S. occidentale*: flowers on very slender often subspreading pedicels, very large and deep violet-blue, the perianth 12–17 mm. long indicating an extreme spread of over 3 cm., the segments slenderly aristulate; stamineal column 5–7 mm. high; capsules broadly oblong, 5–6 mm. high, brown, transversely corrugate, many-seeded, seeds irregularly obovate, 1 mm. in longer diameter, black, faintly pitted to smooth.

Washington: Seattle, May, 1892, in full flower, Chas. V.

Piper, ex Herb. Young Naturalist's Society, Herb. Columbia University; Yakima region, T. S. Brandegee, 1882, mature fruit, Herb. Mo. Bot. Gard.

Oregon: "Prairies Western Oregon," May, 1880, in full flower, Thomas J. Howell; distributed as *S. bellum* Watson in Howell's "Pacific Coast Plants," U. S. Nat. Herb.

Nevada: Washoe Co., alt. 1500 m., July 21, 1896, mature fruit, F. V. Coville and J. B. Leiberg, U. S. Nat. Herb.

An attractive plant evidently with close affinity to *S. occidentale;* though not actually proved to be distinct by the few specimens before me I feel little hesitation in giving it a name. It appears to be less glaucous than *S. occidentale* with narrower more numerous and crowded leaves and stems of thinner texture, slenderer roots, larger often red-purple spathes and narrower mostly more unequal bracts, the inner one especially more attenuate and acute. The highly colored spathes give the plant much the aspect of forms of *S. mucronatum* of the East.

The sheet of specimens cited from Nevada shows fruiting plants which differ strikingly from the other examples, yet for the present I can refer them nowhere else than here. They are very slender with long somewhat flexuous stems and very narrow deflected spathes having the lower part for about 5 mm. scarcely or not at all broader than the stem.

SISYRINCHIUM HALOPHILUM Greene, Pittonia **4**: 34. 17 Mr. 1899

Very pale dull green and white glaucous, mostly low, 10–20 cm. high, stiff and erect or nearly so, the thickened roots densely clustered: leaves half the height of the stem or longer, stiff and thickish, often slightly curved, 1–3 mm. wide, strongly close-striate, smooth-edged, attenuate, acute, in age developing hard-pointed tips: stem from less than 1 mm. to 2 mm. wide, wiry, ascending or outcurved, margined to narrowly winged, the wings thick and firm, smooth-edged: spathes erect, green, rather flat and sharp-edged, 2–4 mm. wide, the bracts striate, subequal or the outer one slightly prolonged; outer bract 15–22 mm. long, usually somewhat convex, acuminate to a short-pointed mostly obtuse often incurved apex, hyaline-margined, united clasping for 3–4 mm. at base; inner bract more broadly hyaline, abruptly acute to obtuse; interior scales more than half the length of the inner bract: flowers 4–8, small to medium-sized, perianth apparently becoming 10 mm. long, violet-blue; capsules 2–3.5 mm. high, subglobose, often broader than long, strongly trigonous, or even trilobulate around an impressed base, pale, scabrous-puberulent, on erect, slightly exserted pedicels: seeds few, 1–3 in each cell, large, becoming 1.5 mm. long, rugulose-pitted.

Nevada: Humboldt Wells, July 25, 1893, Edw. L. Greene, Herb. E. L. G.; Diamond Valley, July, 1868; 5500 ft. alt., S. Watson, Torrey Herb. and Herb. Mo. Bot. Gard.

California: Bishop, Owen's Valley, alt. 5000 ft., May 15, 1897, M. E. Jones, U. S. Nat. Herb.

Type specimens from Humboldt Wells, Nevada, which have been kindly sent me by Professor Greene are not closely matched by anything else I have seen and may perhaps represent a specialized halophilous type.

Sisyrinchium leptocaulon sp. nov.

Growing in erect narrow tufts from coarse fibrous roots, rather bright pale green and glaucescent, the spathes mostly dull purplish: stems numerous, very slender, 20–38 cm. high: 1 mm. or less wide, wiry and subterete, slightly constricted just below the spathe, the almost membranous margins very narrow or even obsolete: leaves about half the height of the stem or less, equally slender or sometimes the shorter ones becoming 2 mm. wide, smooth-edged, attenuate, the apex often linear with a thickened corneous tip, which is obtuse or acute: spathes very small and narrow, the base less flattened and more narrowed than in *S. halophilum*, the bracts subequal or the outer one rarely surpassing the inner 8 mm.; outer bract 12–22 mm. long, hyaline-margined to the short and rigid, linear, obtuse prolongation, closely united clasping for 2–4 mm. at base; inner bract hyaline-margined to the very obtuse or truncate scarious apex; longer interior scales sometimes nearly equaling the inner bract, longer and narrower than in *S. halophilum*: flowers 3–9, blue or violet, small, the perianth apparently only 7–9 mm. long, the stamineal-column 3–6 mm. high; pedicels 13–22 mm. long, erect and exserted for about one quarter of their length, usually flattened and margined: capsules very small, 1.5–3 mm. high, often distinctly pyriform though sometimes abruptly contracted at both ends, finely scabrous-rugulose and sparsely puberulent, pale but much purplish-tinged, thinner-walled than in *S. halophilum* and less strongly trigonous: seeds few, only 1–3 in each cell, subglobose or broadly oblong, finely rugulose, 1–1.5 mm. in longer diameter.

California: Near Lake Tahoe, July 20, 1889, J. Ball, Herb. Acad. Nat. Sci. Phil.

Nevada: Deeth, July 14, 1896, E. L. Greene; Ruby Valley, July, 1868, 6000 ft., S. Watson, ex Torrey Herb. and Herb. U. S. Nat. Mus.

Utah: Parley's Peak, 6000 ft., June, 1869, S. Watson, ex Torrey Herb.

Nearly allied to *S. halophilum* Greene, and possibly a variety of that species, although I am inclined to regard it as quite distinct. It is a taller, and more slender plant than *S. halophilum*, of a very perceptibly brighter and more yellowish shade of green and with straighter and more clustered stems; these are long and exceedingly slender with the wings reduced to little more than membranous edges. The narrower leaves are less strongly striate and thickened than in *S. halophilum* and more slenderly attenuate, and are apparently also without the abrupt membranous expansion at the extreme base although narrowly clasping below for a longer distance. The purplish spathes are less flattened and less decidedly two-edged below, the narrower bracts less strongly striate, narrower and usually more unequal, the outer one less convex with longer linear tip, the inner one more abruptly scarious-obtuse; the capsules are smaller, more pyriform, thinner-walled, less strongly trigonous and more rugulose and scabrous-puberulent.

Sisyrinchium septentrionale sp. nov.

Growing in small tufts 10–25 cm. high, pale and glaucous, discoloring slightly in drying. Leaves ½–¾ the height of the taller stems, equaling the shorter ones, stiff and erect, mostly setaceously slender and .5–1 mm. wide, rarely 1.5 mm., finely close-striate, attenuate to an acute point: stems equally slender with the leaves, stiff and narrowly firm-margined, the edges like those of the leaves smooth or, when young, minutely denticulate: spathes small, purplish or green, often partly double, one or more flowers arising from between the short proper spathe and the closely subtending slenderly prolonged outer bract; inner bract 13–20 mm. long, mostly attenuate and acute, the outer one 2.5–4 cm. long, and united-clasping for 2–3 mm. at base; both bracts hyaline-margined; interior scales about ¾ the length of the pedicels; flowers very small, apparently not more than 3–4 on erect pedicels usually shorter than the inner bract; perianth 4–7 mm. long, acuminate and short aristulate, not retuse, apparently pale rose or violet; stamineal column about 3 mm. high: capsules on firm erect pedicels about 15 mm. long, pale, subglobose, relatively large, 3–5 mm. high.

Assiniboia: Moose Mountain Creek, June 6, 1883, J. M. Macoun, "margins of marshes and streams," just in flower. Herb. Torr. Bot. Club.

Alberta: Near Banff, July 8, 1891, Macoun, in flower and young fruit. U. S. Nat. Herb. and Herb. Mo. Bot. Gard.

Washington: Wilkes Expedition, 1838–42, "Spokane to Colville." U. S. Nat. Herb.

Idaho: Soda Springs, June 21, 1892, A. Isabel Mulford.

Characterized especially by small size, extremely narrow leaves and stems, very small, pale flowers, with the divisions of the perianth non-emarginate, slenderly much prolonged outer bract and relatively large subglobose capsules. Perhaps most nearly related to *S. alpestre*. The specimens from Idaho are without perfect flowers or fruit; though resembling those from British America they have much less elongated primary bract and may not be the same.

Sisyrinchium alpestre sp. nov.

Tufted, becoming 20 cm. high, dull green and glaucous, discoloring slightly when dry. Leaves about half the height of the stem, stiff and erect, .5–2 mm. wide, closely striate-nerved, rather abruptly cuspidate acute, the edges smooth or slightly denticulate above in young leaves: stems slender, 1–1.5 mm. wide, narrowly firm-winged, the edges smooth, distinctly broadened into the base of the spathe: spathes green, narrow, 2 mm. or more wide at base, the outer bract very long and slender, sometimes slightly broadened above the middle, straight or curved, 4.5–6.5 cm. long, surpassing its fellow 2.5–3.8 cm., the margins narrowly hyaline below, united-clasping for 4–6 mm. at base; inner bract 1.8–3 cm. long, narrow and slenderly prolonged, acute, the margins below white-hyaline; interior scales broad, obtuse, about half the length of the fruiting pedicels: flowers on firm erect pedicels 14–18 mm. long, and shorter than the inner bract, small, perianth apparently only 6–10 mm. long, with the divisions not emarginate but narrowed to a short-aristulate tip, faded but appearing white, though in one flower showing the faintest tinge of violet; column becoming 5 mm. long: immature capsules narrowly obovoid-oblong, evidently large and apparently obovoid at maturity, the oldest one 6 mm. long and 4 mm. wide at the top.

Colorado: Como, 9775 ft. altitude, in meadow, Aug. 3, 1895. "Crandall & Cowen," no. 477, Flora of Colorado. U. S. Nat. Herb.

Related to S. *angustifolium*, and perhaps to be referred to an alpine variety of that species, but S. *angustifolium* is also a plant of very high altitudes in Colorado, occurring in a stout and nearly typical form which contrasts notably with the slender plant here described, although more slender Rocky Mountain forms of S. *angustifolium* appear less distinct. An understanding of the true status of the plant must await further material, especially the mature fruit. In any case it is clearly something quite different from the ordinary eastern S. *angustifolium*. In respect of the slenderly prolonged inner bract and small pale flowers with non-emarginate segments the plant shows much similarity to S. *sarmentosum* and in its flowers and general habit to the much smaller S. *alpestre*. It differs from typical S. *angustifolium* in duller gray-green color, greater slenderness, thicker and more closely striate leaves, narrower and more slenderly prolonged bracts which are less strongly nerved and with more hyaline edges, smaller paler flowers with unnotched segments, shorter pedicels, more obovoid-oblong capsules.

S. SARMENTOSUM Suksdorf; Greene, Erythea **3**: 121. 1895.

Tufted or closely massed in growth, 1.5–2.8 cm. high, dull green and glaucescent discoloring in drying: roots slender and numerous: leaves rather thin, erect, equaling the stem or shorter, rather weakly nerved, 1–3 mm. wide, attenuate, acute, smooth-edged or sometimes serrulate when young: stem 1–1.5 mm. wide. narrowly wing-margined, the wings not broadened into the base of the spathe, smooth-edged or obscurely denticulate, erect or somewhat outcurved, simple and leafless, or occasionally developing a terminal node bearing a slender elongated leaf or cluster of several leaves subtending an outcurved peduncle: spathes green, erect or bent forward, narrow, 1–2 mm. wide at base, the bracts foliaceous, thin and somewhat membranous, striate, closely parallel, both narrowly prolonged to the rather abruptly acute or obtusish apex, the outer one 3–6 cm. long, surpassing the inner one 1–2.5 cm., broadened above the middle, the margins narrowly hyaline, united for 3–5 mm. at base; inner bract more than half the length of the outer one, also herbaceously prolonged but narrower and more scarious margined, 2–3.5 cm. long: flowers 1–3, light blue, small, the perianth 7–10 mm. long, the segments not usually emarginate but abruptly contracted into the short-aristulate tip: stamineal column 4–5 mm. long; pedicels slender, in fruit 1.5–2.5 mm. long, ascending or somewhat spreading from about midway in the spathe: capsules thin-walled, subglobose, transversely corrugate at maturity, 4–5 mm. high: seeds not fully mature, black, finely rugulose pitted, asymetrically obovoid or curved, angled.

Washington, Skamania Co., no. 2233, W. N. Suksdorf, August 31, 1893. "Borders of meadows 2000–3000 ft. altitude." In full flower and fruit.

As remarked by Professor Greene in his publication of this species the fitness of the name given by Suksdorf is not evident. I have examined three sheets of the original collection mounting several good sized tufts as well as separate specimens. The printed label reads "stems sometimes rooting at the nodes," but no evidence of such a character is shown by the specimens, which are simple-stemmed and erect, bearing a node, when at all, only at the top.

The plant is clearly an excellent species. Its very narrow bracts alone, especially the narrowly foliaceous inner one, give it an aspect quite different from that of any other species known to me except perhaps *S. alpestre*, which is amply different in other respects. In the nearest approach to this character of the inner bract ever seen in *S. angustifolium* the herbaceous prolongation is more or less abruptly attenuate, quite in contrast with the linear-prolonged and more foliaceous condition characteristic of *S. sarmentosum*. An approach to this condition, but on a larger scale, is sometimes seen in *S. Idahoense* and *S. littorale*. *S. sarmentosum* differs further from *S. angustifolium* in slender, often curved stems with the wings not widened into the base of the spathe, which is frequently deflected and much narrower, fewer smaller flowers on more slender and spreading pedicels, the segments of the perianth not emarginate, smaller fruit.

SISYRINCHIUM LITTORALE Greene, Pittonia, **4**: 33. 17 Mr. 1899.

Apparently little or not at all tufted, stout, 15–35 cm. or more tall, or sometimes much lower and depauperate, apparently not glaucous, or but slightly so, dull green, turning dark in drying: roots fibrous, slender, mostly spreading from a strong woody axis: leaves 2–4 mm. wide, half the height of the stem or longer, erect, rather thin and openly striate-nerved, tapering-acute or acuminate, narrowed to both base and apex, the edges mostly roughened, the inner margins below white-scarious; stems stout, simple, rarely bearing a terminal leaf subtending an erect peduncle, 2–3 mm. wide, prominently winged, the wings with thin serrulate edges, not broadened into the base of the spathe and showing a slight transverse constriction at the top: spathes green, erect, or slightly deflected, 4–6 mm. wide, flat, the bracts foliaceous; primary bract 3.7–8 cm. long, surpassing the inner bract mostly 1–4 cm., only exceptionally twice its length, very gradually narrowed to the acute or obtuse pointed apex, the inner margins below narrowly white-hyaline, united for about 5 mm. at the base; inner bract 2.3–4.8 cm. long, often of nearly equal breadth throughout below the abruptly somewhat obtuse apex, or occasionally narrowly prolonged; interior scales narrow, much shorter than the inner bract: flowers few, 1–4, on pedicels mostly a little shorter than the inner bract, large, deep violet-blue with an orange-yellow eye, the perianth 12–14 mm. long; anthers relatively small; stamineal column about 6 mm. high: capsules large and thick-walled, dark, obovoid or subglobose, 6–8 mm. high, on erect or slightly spreading pedicels 1–2 cm. long: seeds globose, 1.5 mm. in diameter, black, rugulose-pitted almost to maturity when nearly smooth, the umbilicus usually appearing as a mere cleft.

Grassy beaches and shores, coast of Alaska, beginning to flower in late June and early July, fruit ripe in August. So far as known, restricted to the southern Alaskan coast and the only species of *Sisyrinchium* occurring in that territory. Shores of Yes Bay, July 3, 1895, Thos. Howell, no. 1662; Back Bay, July 3, 1895, M. W. Gorman; shores of Behm canal, Aug. 3, 1894, M. W. Gorman; Sitcha, Ferd. Bischoff, 1865–7, Dr. Tiling, 1867.

Although long known and of late years fairly well distributed in collections, this Alaskan plant seems never to have been looked upon as different from the eastern *S. angustifolium* until recently distinguished by Professor Greene, as a matter of fact since the above description was penned. In other writings, as on specimen labels, the plant has been variously referred to as *S. augustifolium* under the names *S. anceps* Cav., *S. Bermudiana* var. *anceps* Gray and *S. mucronatum* Michx. The species is well distinguished from *S. angustifolium* being larger in every way, in fact, notwithstanding its boreal habitat the stoutest species of the simple-stemmed section of the genus. It is not nearly so pale and glaucous as *S. angustifolium*, if at all so, and dries much darker; the leaves and stem are broader, the spathes and bracts larger and of a somewhat different shape, the flowers and especially the fruit larger, the seeds little larger but darker, more globose and more distinctly and narrowly umbilicate. *S. littorale* has perhaps its nearest relative in *S. Idahoense*, but is clearly separable by thinner and broader leaves and stem, smaller flowers and larger fruit.

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THE EFFECT OF CHEMICAL IRRITATION ON THE ECONOMIC COEFFICIENT OF SUGAR

HERBERT MAULE RICHARDS

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The Effect of Chemical Irritation on the Economic Coefficient of Sugar

HERBERT MAULE RICHARDS

It has been known since Raulin's[*] account of the nutrition of fungi that certain metallic salts—notably those of zinc—induce a ~~more~~ rapid growth of fungi than is normal, although, as has been shown by more recent work,[†] he somewhat misinterpreted the action of these salts. It is now well known, as has been demonstrated by many competent experimenters, that a much simpler nutrient solution than was thought necessary in Raulin's time is adequate for an entirely normal development of fungi. With some available source of carbon and nitrogen it is only necessary to add salts containing potassium, magnesium, sulphur, phosphorus, and a trace of iron to provide a suitable substratum for the growth of these saprophytic hyphomycetous fungi which have been experimented with.[‡] The action of the metallic salts noted by Raulin, as well as of others not considered by him, is to be regarded as a response to a chemical irritation which in some way hastens the metabolic activity of the fungus. The result is the production within a given time of a greater amount of dry substance as compared with the same fungus grown under similar conditions, but on solutions free from the irritant. For further particulars as to the range of substances which affect this abnormal growth and

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[*] Études Chimique sur la Vegetation, Ann. d. Sc. Nat. Bot. V. 11 : 91. 1869.

[†] Die Beeinflussung des Wachsthums einiger Pilze durch chemische Reize. Richards, Prings. Jahrb. 30 : 665. 1897.

[‡] Pfeffer, Pflanzenphysiologie, 1 : 374.

[Issued September 22.]

the comparative violence of the irritation, reference is made to the paper already cited.* It will be seen that numerous metallic salts and some organic substances were found which more or less markedly bring about the above noted effect and that their action is constant, although the organic substratum, or the nitrogen source, be changed. Iron salts have a double effect, acting in the first place as a necessary substance for the growth of fungi,† and in the second place in stronger solutions having a distinctly irritating effect.

It was the object of the following recorded experiments to endeavor to throw some light on the physiological action of this chemical irritation, to approach a little nearer to discovering the underlying cause of the abnormal growth of these fungi under such conditions. As a first step in this direction cultures and analyses were made to determine if there was any regular and considerable variation in the economic coefficient of the organic food material supplied to the fungus.

Because of its greater ease in determination sugar was employed as the organic basis of the nutrient solution and many analyses were made to determine what relation the weight of dry substance produced for the amount of sugar used bore between the normal culture, and those growing under chemical irritation. It would, no doubt, have been interesting for further comparison to have used other organic substrata, such as glycerin, but it was hardly necessary in this instance to do so in order to prove the point desired, and the difficulty of accurate quantitative determination of glycerin made it impracticable with the facilities at hand for such research.

For the cultures the usual method of growing the fungi in flasks was employed. For most of the experiments the ordinary Florence flasks of about 125 cc. capacity were used; they were selected with due care as regards similarity of shape, and any error due to difference in area of the surface of the culture fluid could not have been considerable. In these flasks 50 cc. of the nutrient solution was used; for larger quantities, where 100 cc. was taken, Erbenmeyer flasks of Jena glass, about 250 cc. in capacity, were selected. The sowings of the fungus spores were not made by the addition of water in which the spores hung suspended, since it was desired not to weaken the solutions and thereby involve another chance of error in the subsequent analyses. Instead of this method, small pieces of heavy glass rod (about 8 mm. diam.) were taken, their ends slightly moistened and then rubbed on the dry stock culture of the desired fungus. The bits of glass rod, with the attached spores, were then dropped in the prepared flasks; a slight shaking served to dislodge the spores which promptly rose to the surface and with sufficiently even distribution to insure an even growth of the fungus when they germinated. In this way the cultures were provided with at least an approximately equal number of spores, certainly above the maximum required to produce an unbroken carpet of mycelium, and that, as has already been shown, is sufficient to make an equal growth on surfaces of the same area.

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* Richards, *l. c.*

† Molisch, Pflanze in ihren Beziehungen zum Eisen. Jena, 1892. Benecke, Die zur Ernährung der Schimmelpilze nothwendige Metalle. Prings. Jahrb. 27: 487. 1895.

As in the previous investigations the greatest care was taken to have all of the substances used for the culture fluids of the greatest practicable degree of purity. The chemically pure salts prepared by Merck & Co. were used and again recrystallized. The sugar was of the best quality obtainable in the market and showed on many tests to be free from impurities. The water was twice distilled, once over a tin-lined still and the second time over glass with alkaline permanganate. It should be added that due care was taken that none of the permanganate passed over. By all tests employed as well as by the evidence of the experiments themselves, the water was shown to be pure. For the irritant substances, the zinc sulphate and lithium carbonate, from which the chloride was prepared, were kindly given the writer by Professor T. W. Richards, of Harvard University. Of the other salts the nickel sulphate and the ferric chloride were the purest obtainable and further purified by successive recrystallizations.

Only one nutrient solution was used—that recommended by Pfeffer * which is identical with solution *A* of the writer's previous paper.† The formula is as follows:

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* Election organischer Nährstoffe. Prings. Jahrb. 27: 238. 1895. Pflanzenphysiologie, 1: 375.

† Richards, *l. c.* p. 667.

NH_4NO_3	1.00
KH_2PO_4	.50
$MgSO_4$	.25
Sugar	5.00
Water	100.00
Trace of iron	

The fungi experimented with were *Sterigmatocystis* (*Aspergillus*) *nigra*, *Penicillium glaucum* and *Trichothecium roseum*.

In making up the solutions it was found most convenient as well as most accurate to prepare them in considerable quantities with all the ingredients except the sugar and of exactly twice the strength desired. Of the solutions thus prepared and with their respective amounts of the irritant substances added, 25 or 50 cc. were taken and exactly the same amount of an accurately prepared 10% sugar solution added. In all of the processes the same pipettes were used throughout and were handled in the same manner, great care being taken of course not to contaminate one solution with another, particularly the control solutions. In this manner it was found practicable to prepare quickly solutions containing a standard of 5% sugar with all the accuracy needed for this work. Numerous test analyses were made of solutions made up after this manner and it was found that they did not vary more than 0.005 grm. in sugar content. It is obvious that it was needful to have confidence in the accuracy of the solutions for upon this point depended the entire result of the work.

When the crop of fungus was harvested the flasks were well shaken and the contents filtered. To the filtrate 1 cc. of a 5% solution of HCl was added and time being allowed for the inversion of the sugar the HCl was then neutralized with Na_2CO_3 and a sufficient amount of water added to dilute the solution to just twice its original bulk, thus weakening it sufficiently to allow of an accurate analysis. From these solutions always two and sometimes more analyses were made. The control cultures were usually two in number; the average between them being the figures printed in the tables. The determination of the sugar was made by the Fehling method. For this purpose the usual solutions of $CuSO_4$ and of alkaline Rochelle salts were made up and mixed freshly for each set of analyses. The Fehling solution was tested against a standard sugar solution each time. The factor (Allen's Industrial Chemistry, vol. I., p. 226) of 10 cc. Fehling solution = 0.0475 cane sugar after inversion was used as the basis of all calculations.

The dry weight of fungus was determined in the usual way, the crop having been collected on a weighed filter was dried in an oven at the temperature of about 70° C. to constant weight.

In the absence of thermostat the cultures were grown at the ordinary room temperature in the laboratory or at a somewhat higher temperature in a room which served also as a conservatory. The cultures were consequently subjected to some fluctuation of temperature, possibly somewhat to the disadvantage of the results obtained. It would, undoubtedly, have been preferable to have grown the *Sterigmatocystis* cultures at a point nearer the optimum for that fungus between 30° and 34° C. In the case of the *Penicillium* the room temperature approximated more nearly the lower optimum of that fungus. In spite of the variations, however, the results for both correspond satisfactorily, the *Sterigmatocystis* cultures being allowed to grow for a somewhat longer period than would otherwise have been necessary.

It would, indeed, have been well to have determined the respiration quotient in relation both to the increased growth and the economic coefficient but the writer was unable at the time to do so, although, it is his intention to experiment in this line in the future. The facts demonstrated, however, show much as to the economic coefficient of the sugar in relation to the abnormal growth caused by chemical irritation despite the fact that at present they cannot be compared with the CO_2 coefficient.

It will be seen by comparison with the results of Kunstmann* that the averages of the economic coefficient obtained from the control cultures is correct. This average approximates 2.00 for the ratio between the amount of sugar used for the dry weight of fungus produced or, as may better be expressed, 0.50 grm. of dry substance for each gram of sugar consumed. In table I. of Kunstmann's paper the average coefficient for those cultures grown between the temperatures of 17° and 25°C. is 2.05 = 0.49. This serves as a check for the results recorded herein.

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* Ueber das Verhältniss zwischen Pilzernte u. verbrauchter Nährung. Inaug. Dissert., Leipzig, 1895.

Taking the control cultures as a base from which comparison can be made, those cultures to which an irritant substance was added now demanded attention. From the results previously obtained such degrees of concentration as showed a marked irritant were employed, the stronger solutions where in the case of the poisonous salts a secondary toxic effect was noted, were not employed, except in one series. With this last named exception all of the ZnSO4 series comprised the following percentages of the anhydrous salt 0.002 %; 0.004 %; 0.008 %; 0.032 %; the last named concentration being just within the range of the toxic effect. In those cultures to which iron salts were added, a much greater degree of concentration is indicated, for it will be remembered that iron has a double effect, first as a necessary food substance for the fungus, and secondarily, when present in larger quantities as an irritant. Consequently the percentages of Fe_2Cl_6 were 0.05 %; 0.10 %; 0.20 %. In the same way the lithium salt, in this case lithium chloride, although not an indispensable ash constituent is not effective as an irritant, except in comparatively strong solutions, and apparently does not exert any poisonous influence on these hyphomycetous fungi. It was used in the following concentrations of 0.125 %; 0.350 %; 0.375 %. In the few series with nickel salts the sulphate was not used in concentrations very much greater than with the ZnSO4, for like the latter salt it is ultimately a poison. The citations above given are in fractions of a per cent., for the sake of comparison with the writer's previous paper which has already been referred to, but it will be observed that in the tables the equivalents of the solutions are given in fractions of the *normal* solution. This method of reckoning in gram-atoms of the irritant or toxic base was employed by Kahlenberg and True* and affords a much better standard for comparison for future works in this line than expressions in terms of per cent. Since in every salt used in these experiments herein described the acid may be regarded as entirely neutral in its effect on the growth of the fungi the whole of the irritant effect is to be referred to the base of the particular salt employed.

Upon examination of the tables it will be seen that the curve of the economic coefficient of the sugar rises with the increase in the dry weight of the fungus, but more abruptly. For instance, in the case of the cultures with $ZnSO_4$ as in the case of irritation it attains its maximum of 0.58 (see general averages, Table V.) at a concentration of 0.004% of this salt, at which point also the maximum weight is shown. In solutions of greater strength the coefficient falls off but more rapidly than does the abnormal growth. At a concentration of 0.032% when the toxic effect of the $ZnSO_4$ begins to be noticeable the economic coefficient has fallen almost to that of the control as also has the weight of dry substance. In yet stronger solutions in which the growth is much retarded the amount of sugar used remains, however, in about this same relation. The cultures in which Fe_2Cl_6 was used do not show the same regularity. Up to the strength of 0.1% the rise of the economic coefficient of the sugar from 0.46 to 0.56 keeps pace with the increase of weight from about 330 mg. to 800 mg. and agrees with the results found with the $ZnSO_4$, but beyond that at a concentration of 0.2% the average of the economic coefficients falls somewhat while the average weight of the fungus crop increases. This was more apparent in the *Penicillium* cultures than in those with *Sterigmatocystis*. In the latter both the weight and ratio remain about equal, while in the *Penicillium* only one series shows any increase (XVIII.) and series XX. indicates a distinct falling off of the coefficient although a considerable gain in weight is shown in the 0.2% culture over that with but 0.1% of Fe_2Cl_6. It is to be observed, however, that in this case the ratio of 0.82 given for the 0.1% culture stands alone in being the highest found in any series. It is this series that has so materially affected the averages, but since no legitimate reason could be discovered for throwing it out it was necessarily included with the rest. In the series with LiCl the two with *Sterigmatocystis* show the same peculiarity, for in the stronger concentration of 0.375% there is a distinct gain in weight with some falling off in the availability of the sugar consumed (series XXII., XXIII.). In the *Penicillium* cultures the ratio rises even in the strongest solution employed but at 0.375% the gain does not correspond to the increase in weight over the 0.25% concentration. In the *Trichothecium* series there is no marked change. All of the series with LiCl agree, however, in showing in the weaker solutions of 0.125% and 0.25% an increase of the ratio over that found in the control cultures corresponding to that found in other experiments. A few series were tried with a nickel salt, the results falling in line with those obtained with the $ZnSO_4$ cultures, the curve of the economic coefficient of the sugar following a course similar to that of the gain in weight.

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* Bot. Gaz. 22: 81–124. 1896.

In order to compare the abnormal growth caused by these inorganic salts with that produced by organic substances a couple of series were carried through with cocaine as an irritant. As is shown in the previous paper these fungi do not respond very violently to the organic substances therein mentioned and cocaine was selected as being the most potent. The results were surprisingly definite; as will be seen a distinct increase of weight resulted with also an appreciable gain in the ratio amounting to about 0.04.

It will be seen that, although the effectiveness of sugar as a source of organic nutrition increases in general with the increase of growth induced by the irritant substance and diminishes as the latter diminishes, the economic coefficient does not exactly parallel in its curve the gain of dry substance. For instance, supposing that the dry weight of a control culture be 1 and the economic coefficient of the sugar be 0.50, although the dry weight of a culture under similar conditions but with the addition of an irritant be 2 the economic coefficient is not 1.00 but much lower on the average, say 0.60. Indeed, it is not to be expected that the economic coefficient should vary in the same proportion as the increase of weight. Such an example as given above—the ratio of weights is often higher as much as 1 to 3—would require that *all* of the sugar used be available for the production of the fungus mycelium, an impossibility in any event since such a condition would preclude the respiration of any CO_2. Nor is it necessary that the available portion of the sugar used increase in a similar proportion to the dry substance, for it will be remembered that the effect of the irritant substance must, as long as the food supply is not greatly exhausted, be cumulative. Even a smaller increase of the economic coefficient of the sugar than that absolutely found would serve to account for a considerable increase in weight. It is evident from the experiments that of the sugar used more is actually available for the fungus and that provides for and implies a more rapid growth of the latter. Granting this together with the accompanying necessity that the irritant substance is acting continually, it is easy to understand that any gain in weight might be indefinitely multiplied as long as the food supply was sufficient. Since, up to a certain point, the economic coefficient of the sugar rises with the increase of dry weight shows that there must be some relation between the two, that the latter phenomenon must in some measure at least be dependent upon the former. The actual gain in the economic coefficient must at any one time be very small and it is highly probable that given time any two cultures, the one with and the other without an irritant substance added would tend to become equalized.

As the weight of the crop falls with the increase of $ZnSO_2$ so also does the economic coefficient diminish, but the writer would not be prepared to maintain that the toxic effect of this substance is in itself merely the diminishing of the economic coefficient to a vanishing point. It is not to be supposed that the irritant salt acts directly on the sugar but on the fungus in which no doubt other and more subtle changes in the protoplasm are brought about. As was shown indeed in one series even in very much stronger solutions of $ZnSO_4$ where the growth is materially diminished by the salt, the economic coefficient remains practically the same as in the normal. A further discussion of the *toxic* action of this salt is, however, not within the limits of this paper.

While it would be manifestly improper with evidence afforded by only a comparatively few series of experiments from but a single point of view to theorize too widely as to the nature of this chemical irritation, the writer feels justified in arriving at the conclusion that the increase in the availability of the sugar consumed is at least one factor and an important one in determining the increase of growth. In just what way the irritant influences the metabolic activity of the fungus hyphae must be at present at least merely a matter of speculation. The irritant substance is not in itself a source from which energy is available.

In their action as poisons the salts of zinc, nickel, manganese and lithium would come under the third group of poisons as recognized by Loew in his " Naturliche System der Gift Wirkungen,"* which includes those bases that by their power of forming salts with the protein substances of the protoplasm induce disturbances which ultimately end in death. It may be that such indeed is the case, but the poisonous substances so formed being in such minute quantities, owing to the dilute solutions used, do not serve to kill the protoplasm, but merely stimulate its molecular activity in an endeavor to throw off the irritant substance, or to induce what might be called a secondary katalytic action. The results with the salts of iron which are not poisonous do not, however, uphold such a view, yet it is not impossible that in stronger solutions the apparently inocuous base, iron, might prove to exert a poisonous influence. This might be impossible to demonstrate, since the necessary concentration to produce any deleterious effect would be so great as to confuse the results with the osmotic action of the solution. If it is not possible to admit any such semi-toxic action on the part of the irritant substances, it is necessary to fall back upon the idea of their action being strictly katalytic, as suggested by Pfeffer,* or simply to include the phenomenon under the comprehensive phrase "physiological counter-reaction."

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* Munich, 1893. See also Davenport, Experimental Morphology, 1 : 12.

The results of these experiments may be briefly stated as follows:

That the direct action of irritant substances (in this case inorganic salts), which produce an increased growth of certain fungi is to enable the latter to dispose more economically of the sugar used (*i. e.*, to raise the economic coefficient of the sugar) thereby permitting a more rapid production of dry substance in a given time.

That the increase of the economic coefficient is not in proportion to the percentage increase in weight.

That the economic coefficient again decreases when in poisonous substances the maximum of growth is passed, but that it apparently does not ever fall much below the normal.

This work was begun in the Cryptogamic Laboratory of Harvard University in 1897–98 and completed at Barnard College, New York, in 1898–99. The writer would here express his thanks to Professor H. B. Hill, Director of the Chemical Laboratory of Harvard University, for his courtesy in allowing the use of the facilities of that laboratory.

NEW YORK, May, 1899.

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* Pfeffer, Prings. Jahrb. **28**: 238. 1895.

TABLE I.

In all of the cultures a standard of 5% sugar was used. The series are indicated in Roman numerals.

I. *Sterigmatocystis nigra.* $ZnSO_4$ added. Grown at room temp. about 20°C. Harvested one week after sowing.

% $ZnSO_4$. Fraction normal $ZnSO_4$.	Control.	.002% .000125	.004% .00025	.008% .0005	.032% .002
I.					
Weight crop mg.	535	846	1020	945	
Sugar used mg.	930	1220	1400	1315	
Sugar residue mg.	1570	1280	1100	1185	
Econ. Fungus : sugar.	1.74	1.44	1.37	1.39	
Coeff. Sugar : fungus.	0.57	0.69	0.73	0.74	
II as in I. Temp. about 20°C. 7 days.					
Weight crop mg.	640	912	1104	842	800
Sugar residue mg.	1845	1315	1300	1370	1305
Sugar used mg.	955	1185	1200	1130	1195
Econ. Fungus : sugar.	1.49	1.29	1.09	1.34	1.50
Coeff. Sugar : fungus.	0.67	0.77	0.92	0.75	0.67
III as in I. Temp. about 20°C. 6 days.					
Weight crop mg.	330	535	817	800	400
Sugar residue mg.	1825	1605	1320	1284	——
Sugar used mg.	675	895	1180	1216	——
Econ. Fungus : sugar.	2.00	1.67	1.44	1.52	——
Coeff. Sugar : fungus.	0.49	0.59	0.69	0.66	——
IV as in I. Temp. circa 24°C. 8 days.					
Weight crop mg.	510	830	943	912	615
Sugar residue mg.	1306	1164	1029	1032	1461
Sugar used mg.	1194	1336	1471	1468	1039
Econ. Fungus : sugar.	1.95	1.73	1.56	1.61	1.69
Coeff. Sugar : fungus	0.51	0.59	0.64	0.62	0.59
V as in I. Temp. circa 24°C. 5 days.					
Weight crop mg.	305	523	610	600	520
Sugar residue mg.	1912	1637	1536	1540	1164
Sugar used mg.	588	863	964	960	925
Econ. Fungus : sugar.	1.83	1.65	1.58	1.60	1.74
Coeff. Sugar : fungus.	0.55	0.60	0.64	0.62	0.59
VI as in I. Temp. circa 20°C. 7 days.					
Weight crop mg.	308	527	622	580	489
Sugar residue mg.	1980	1620	1480	1525	1705
Sugar used mg.	620	880	1020	975	895
Econ. Fungus : sugar.	2.01	1.67	1.64	1.68	1.83
Coeff. Sugar : fungus.	0.50	0.61	0.60	0.62	0.55

TABLE II.

VII. *Penicillium glaucum.* $ZnSO_4$ added. Grown at room temperature. Harvested nine days after sowing. 100 cc. culture fluid in flasks 200 cc. capacity.

% $ZnSO_4$. Fraction normal $ZnSO_4$.	Control.	.002% .000125	.004% .00025	.008% .0005	.032% .0020
VII.					
Weight crop mg.	430	613	940	836	503
Sugar left mg.	4093	3809	3130	3480	3500
Sugar used mg.	997	1191	1870	1520	1500
Econ. } Fungus : sugar.	2.11	1.96	1.99	1.81	2.30
Coeff. } Sugar : fungus.	0.46	0.51	0.50	0.55	0.46
VIII as in VII. Temp. circa 20°C. 9 days.					
Weight crop mg.	395	705	693	674	581
Sugar residue mg.	4048	3393	3409	3403	3559
Sugar used mg.	952	1607	1591	1597	1441
Econ. } Fungus : sugar.	2.41	2 28	2.31	2.37	2.48
Coeff. } Sugar : fungus.	0.41	0.44	0.44	0.44	0.41
IX as in VII. Temp. circa 20°C. 8 days.					
Weight crop mg.	295	416	683	618	
Sugar residue mg.	4426	4322	3873	3937	
Sugar used mg.	574	678	1127	1063	
Econ. } Fungus : sugar.	1.95	1.70	1.65	1.72	
Coeff. } Sugar : fungus.	0.51	0.59	0.61	0.58	
X as in VII. Temp. circa 20°C. 8 days.					
Weight crop mg.	362	700	910	685	525
Sugar left mg.	4184	3710	3453	3550	3793
Sugar used mg.	816	1290	1547	1450	1207
Econ. } Fungus : sugar.	2.26	1.85	1.70	2.12	2.30
Coeff. } Sugar : fungus.	0.43	0.54	0.59	0.47	0.44
50 cc.	*Trichothecium roseum.*				
XI Conditions as in VII. *Trichothecium roseum.* Harvested 10 days after sowing. Temp. circa 22°C.					
Weight crop mg.	112	203	203	196	091
Sugar residue mg.	2231	2052	2064	2013	2278
Sugar used mg.	269	448	436	447	222
Econ. } Fungus : sugar.	2.40	2.21	2.15	2.28	2.44
Coeff. } Sugar : fungus.	0.41	0.45	0.48	0.44	0.41
XII as in XI. *Trichothecium roseum.* Temp. circa 22°C.					
Weight crop mg.	95	205	183	194	104
Sugar residue mg.	2298	2098	2152	2126	2281
Sugar used mg.	202	402	348	374	219
Econ. } Fungus : sugar.	2.13	1.99	1.90	1.93	2.11
Coeff. } Sugar : fungus.	0.48	0.51	0.53	0.52	0.46

TABLE III.

XIII. *Sterigmatocystis nigra*. Excess of Fe_2Cl_6 added. Temperature about 25°C. Harvested seven days after sowing. Culture flasks 125 cc. 50 cc. culture fluid.

% Fe_2Cl_6 Fraction normal Fe_2Cl_6.	Control.	0.050% .00015	0.100% .0003	0.200% .0006
XIII.				
Weight crop mg.	320	515	710	700
Sugar residue mg.	1796	1516	1187	1205
Sugar used mg.	704	984	1313	1295
Econ. Fungus : sugar.	2.20	1.91	1.85	1.85
Coeff. Sugar : fungus.	0.45	0.52	0.54	0.54
XIV as in XIII. Temp. circa 23°C. 6 days.				
Weight crop mg.	285	491	683	694
Sugar residue mg.	1944	1616	1346	1369
Sugar used mg.	556	884	1154	1131
Econ. Fungus : sugar.	1.95	1.80	1.69	1.63
Coeff. Sugar : fungus.	0.51	0.55	0.60	0.62
XV as in XIII. Temp. circa 33°C. 6 days.				
Weight crop mg.	305	500	690	725
Sugar residue mg.	1890	1595	1355	1268
Sugar used mg.	610	905	1145	1232
Econ. Fungus : sugar.	2.00	1.81	1.66	1.70
Coeff. Sugar : fungus.	0.50	0.55	0.61	0.59
XVI as in XIII, but with 100 cc. Temp. circa 24°C. 6 days.				
Weight crop mg.	711	1240	1635	1610
Sugar residue mg.	3364	2446	2028	1796
Sugar used mg.	1636	2554	2972	3204
Econ. Fungus : sugar.	2.31	2.06	1.94	1.99
Coeff. Sugar : fungus.	0.46	0.49	0.52	0.50

TABLE IV.

XVII. *Penicillium glaucum.* Excess of Fe_2Cl_6. added. Temp. about 20°C. Harvested nine days after sowing. Culture flasks 125 cc. 50 cc. culture fluid.

% Fe_2Cl_6. Fraction normal Fe_2Cl_6.	Control.	0.051 % .00015	0.10 % .0003	0.20 % .0006
XVII.				
Weight crop mg.	160	300	410	390
Sugar residue mg.	2108	1837	1627	1650
Sugar residue mg.	392	663	873	850
Econ. Fungus : sugar.	2.45	2.21	2.13	2.18
Coeff. Sugar : fungus.	0.41	0.45	0.47	0 45
XVIII *Penicillium* as in XVII Temp. circa 21°C. 7 days.				
Weight crop mg.	148	273	386	420
Sugar residue mg.	2155	1930	1672	1647
Sugar used mg.	342	570	818	853
Econ. Fungus : sugar.	2.31	3.09	2.12	2.03
Coeff. Sugar : fungus.	0.43	0.46	0.46	0.49
XIX *Penicillium* as in XVI 100 cc. Temp. circa 19°C. 8 days.				
Weight crop mg.	375	830	1,012	.981
Sugar residue mg.	4128	3324	3148	3125
Sugar used mg.	872	1676	1852	1875
Econ. Fungus : sugar.	2.30	2.02	1.83	1.91
Coeff. Sugar : fungus.	0.43	0.49	0.54	0.52
XX *Penicillium* as in XIX 100 cc. Temp. circa 19°C. 10 days.				
Weight crop mg.	546	945	1.270	1.348
Sugar residue mg.	3890	3265	3450	2816
Sugar used mg.	1110	1735	1550	2184
Econ. Fungus : sugar.	2.03	1.84	1.22	1.62
Coeff. Sugar : fungus.	0.49	0.54	0.82	0.62
XXI *Penicillium* as in XIX 100 cc. Temp. circa 19°C. 9 days.				
Weight crop mg.	280	463	617	680
Sugar residue mg.	4385	4074	3891	3810
Sugar used mg.	615	926	1109	1190
Econ. Fungus : sugar.	2.16	2.00	1.71	1.75
Coeff. Sugar : fungus.	0.46	0.50	0.58	0.58

TABLE V.

Average of $ZnSO_4$ Cultures.

% $ZnSO_4$. Fraction Normal $ZnSO_4$.	Control.	.002% .000125	.004% .00025	.008% .0005	.032% .002
Sterigmatocystis, 6 series.					
Average weight crop mg.	438	695	853	780	471
Econ. Fungus : sugar.	1.91	1.65	1.45	1.47	1.76
Coeff. Sugar : fungus.	0.52	0.60	0.69	0.68	0.57
Penicillium, 4 series.					
Average weight crop mg.	370	650	807	707	402
Econ. Fungus : sugar.	2 20	1.98	1.85	1.90	2.35
Coeff. Sugar : fungus.	0.45	0.52	0.54	0.53	0.44
Av. Econ. Coeff, both fungi.					
Fungus : sugar.	2.05	1.83	1.65	1.73	2.00
Sugar : fungus.	0.48	0.56	0.62	0.60	0.50

Average of Fe_2Cl_6 Cultures.

% Fe_2Cl_6. Fraction Normal Fe_2Cl_6.	Control.	.050% .00015	.10% .0003	.20% .0006
Sterigmatocystis, 4 series.				
Average weight crop mg.	316	532	725	731
Econ. Fungus : sugar.	2.11	1.89	1.78	1.79
Coeff. Sugar : fungus.	0.48	0.52	0.56	0.56
Penicillium, 5 series.				
Average weight crop mg.	354	660	881	906
Econ. Fungus : sugar.	2.25	2.07	1.80	1.90
Coeff. Sugar : fungus.	0.44	0.48	0.55	0.52
Av. Econ. Coeff., both fungi.				
Fungus : sugar.	2.18	1.98	1.79	1.85
Sugar : fungus.	0.46	0.50	0.56	0.54

TABLE VI.

Series with LiCl added. XXII., XXIII., *Sterigmatocystis;* XXIV.-XXVI., *Penicillium;* XXVI., *Trichothecium.* All in 125 cc. flasks with 50 cc. culture fluid.

% LiCl. Fraction normal LiCl.	Control.	0.125 % .03	0.250 % .06	0.375 % .09
XXII. *Sterigmatocystis.* Temp. circa 24°C. 8 days.				
Weight crop mg.	295	435	420	681
Sugar left mg.	1778	1539	1580	1090
Sugar used mg.	722	961	920	1410
Econ. Fungus : sugar.	2.45	2.21	2.19	2.07
Coeff. Sugar : fungus.	0.41	0.45	0.45	0.49
XXIII. *Sterigmatocystis.* Temp. circa 23°C. 6 days.				
Weight crop mg.	315	451	532	610
Sugar left mg.	1892	1733	1617	1548
Sugar used mg.	608	767	833	952
Econ. Fungus : sugar.	1.93	1 70	1.66	1.56
Coeff. Sugar : fungus.	0.52	0.59	0.60	0.64
XXIV. *Penicillium.* Temp. circa 18°C. 9 days.				
Weight crop mg.	180	290	301	466
Sugar residue mg.	2115	1940	1964	1699
Sugar used mg.	385	560	536	801
Econ. Fungus : sugar.	2.15	1.93	1.78	1.72
Coeff. Sugar : fungus.	0.48	0.52	0.56	0.58
XXV. *Penicillium.* Temp. circa 20°C. 7 days.				
Weight crop mg.	135	242	288	501
Sugar residue mg.	2224	2085	2031	1712
Sugar used mg.	256	414	469	787
Econ. Fungus : sugar.	1.90	1.71	1.63	1.57
Coeff. Sugar : fungus.	0.52	0.59	0.60	0.61
XXVI. *Penicillium.* Temp. circa 19°C. 9 days.				
Weight crop mg.	121	264	303	285
Sugar residue mg.	2231	1964	1924	1950
Sugar used mg.	269	536	576	550
Econ. Fungus : sugar.	2.22	2.03	1.90	1.93
Coeff. Sugar : fungus.	0.45	0.49	0.53	0.52
XXVII. *Trichothecium roseum* Temp. circa 20°C. 8 days.				
Weight crop mg.	101	195	276	344
Sugar residue mg.	2286	2143	1986	1877
Sugar used.	214	357	513	623
Econ. Fungus : sugar.	2.12	1.94	1.86	1.81
Coeff. Sugar : fungus.	0.47	0.52	0.54	0.55

TABLE VII.

Sterigmatocystis nigra. XXVIII.-XXX. with $NiSO_4$. XXXI. and XXXII. with Cocaine. Otherwise as in previous cultures. 50 cc. culture fluid.

% $NiSO_4$. Fraction Normal $NiSO_4$.	Control.	0.008 % .0005	0.016 % .001	0.033 % .002
XXVIII. Temp. circa 24°C. 7 days.				
Weight crop mg.	250	360	885	210
Sugar residue mg.	2043	1916	1156	2099
Sugar used mg.	457	584	1344	401
Econ. Coeff. Fungus : sugar.	1.83	1.60	1.52	1.91
Econ. Coeff. Sugar : fungus.	0.55	0.62	0.67	0.53
XXIX as in XXVIII. Temp. circa 24°. 7 days.				
Weight crop mg.	231	365	430	215
Sugar residue mg.	1969	1740	1714	2010
Sugar used mg.	530	760	786	490
Econ. Coeff. Fungus : sugar.	2.30	2.14	1.92	2.28
Econ. Coeff. Sugar : fungus.	0.44	0.48	0.53	0.44
XXX as in XXVIII. Temp. circa 23°. 7 days.				
Weight crop mg.	305	482	595	300
Sugar residue mg.	1835	1555	1455	1860
Sugar used mg.	665	945	1045	640
Econ. Coeff. Fungus : sugar.	2.18	1.95	1.76	2.13
Econ. Coeff. Sugar : fungus.	0.46	0.51	0.57	0.47
XXXI Cocaine, otherwise as in XXVIII.	Control.	0.1 %	0.2 %	
Weight crop mg.	360	520	600	
Sugar residue mg.	1658	1382	1192	
Sugar used mg.	842	1118	1308	
Econ. Coeff. Fungus : sugar.	2.34	2.15	2.18	
Econ. Coeff. Sugar : fungus.	0.42	0.48	0.46	
XXXII Cocaine, otherwise as in XXVIII.				
Weight crop mg.	275	510	591	
Sugar residue mg.	1929	1557	1616	
Sugar used mg.	572	943	884	
Econ. Coeff. Fungus : sugar.	2.08	1.85	1.80	
Econ. Coeff. Sugar : fungus.	0.47	0.54	0.55	

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 163

STUDIES IN SISYRINCHIUM—V: TWO NEW EASTERN SPECIES

BY EUGENE P. BICKNELL

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Studies in Sisyrinchium—V: Two new eastern Species

By Eugene P. Bicknell

Up to the present time four species of *Sisyrinchium* have been recognized in the flora of the eastern coastwise states from New Jersey northward. These are *S. angustifolium* Miller, the commonest species of New York and New England and the only one ranging far northward and eastward through Maine to the provinces; *S. graminoides*, extending from east Massachusetts far southward and westward; *S. Atlanticum*, abundant along the coast from Massachusetts southward and occasionally found inland, as at Stratton, Vermont (A. J. Grout) and Concord, New Hampshire (W. W. Eggleston), and *S. mucronatum* Michx., common in the Alleghany region of east Pennsylvania and extending to central New York but as yet not reported east of the Delaware River.

To these four species two others must now be added, one a coastwise plant of New York and New Jersey, the other occuring from southern New Jersey southward. These new species are here described.

Sisyrinchium arenicola

Closely caespitose in stiff erect tufts 20–40 cm. tall from short woody rootstocks, the tufts coarsely brown-fibrous at base, the fibrous roots numerous, long and slender, becoming nearly black: stems and leaves rather bright green, sometimes glaucescent, readily discoloring to brown or black in drying, the spathes and often the stems and leaves purplish-tinged: leaves usually over half the height of the stem, stiff and erect, often slightly curved, .5–3 mm. wide, cuspidate-attenuate, strongly close-striate, minutely cellular-puncticulate between the nerves, the edges denticulate-serrulate to smooth: stem erect but often forming a shallow double curve, sometimes spirally twisted, 1–3 mm. wide, the distinct wings firm, striate, denticulate-serrulate or smooth; bracteal leaf conspicuous, erect, continuing the line of the stem, often slightly incurved, attenuate-acute, usually subequal with the peduncles, the rather broad compressed base strongly striate and oppositely bicarinate; peduncles 2–4, suberect or somewhat outcurved, in their early development appearing lateral from the stem, approximate or, when only two, the outer one often divergent, somewhat unequal, very short or elongated, 3–12 cm. long, stiff, wing-margined and serrulate, mostly 1 mm. or more wide (.5–2 mm.): spathes erect, the mostly cuspidate-acuminate bracts striate with delicate raised nerves, slightly unequal or the outer one slenderly prolonged for as much as 2 cm. when, as not infrequently occurs, the stem is simple; interior scales brownish-tinged, becoming over ¾ the length of the inner bract: flowers deep violet-blue, often numerous, 3–12, on nearly erect, slightly exserted pedicels 15–22 mm. long, which become somewhat spreading above in fruit; perianth 8–10 mm. long; stamineal column 4–5 mm. high, anthers small, bright orange-yellow; capsules dark and thick-walled, subglobose to obovoid, 3–5 mm. high: seeds black, globose, 1–1.5 mm. in diameter, distinctly pitted and with a rather prominent umbilicus.

In sand or sandy soil near the coast, Long Island to New Jersey, flowering from June till August, the fruit sometimes persisting till October.

New Jersey: Point Pleasant, Ocean Co., July 17, 1882, E. H. Day: Monmouth Co., Oct. 2, 1886, N. L. Britton.

New York: Staten Island, Todt Hill, June 12, 1887, and Tottenville, Aug. 3, 1890, N. L. Britton; Long Island, Southampton, June, 1898, W. N. Clute; Hempstead, June 30, 1899, Miss Fanny A. Mulford; Sag Harbor, July 20, 1899, still in flower, N. L. Britton; Amagansett, Aug. 7, 1899, Miss E. Babcock.

The specimens cited are contained in the herbaria of Columbia University and the New York Botanical Garden and in my private collection.

An interesting and unexpected addition to our eastern coast flora, of very restricted range, so far as yet appears, but in all probability extending further south than New Jersey and eastward to the New England coast.*

The species is a perfectly distinct one and though appearing intervenient with *S. graminoides* and *S. Atlanticum* is in closer relationship with a group of more southern species, including *S. xerophyllum* Greene and *S. rufipes*, characterized by a dense fibrous coating about the base of the tufts. In the possession of this character *S. arenicola* differs notably from all other species of the northern states except *S. Farwellii*, a very different species in ther respects.

On herbarium sheets specimens sometimes show fully as much discoloration as *S. graminoides* and might be easily passed over for that species, but a moment's attention will discover that the plant is more caespitose and stiffer in habit than *S. graminoides* with narrower and more attenuate leaves which are thicker and more strongly striate; other evident differences are shorter, frequently clustered peduncles, stiffer and more striate bracts, more numerous flowers and smaller capsules on less exserted and spreading pedicels.

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* Mr. Bicknell writes, under the date of September 14, that he finds *S. arenicola* the common species on Nantucket Island.—Ed.

As compared with *S. Atlanticum*, *S. arenicola* is stouter and stiffer, never developing a flexuous prolongation of the stem from a lower node, and having much less membranous bracts which are decidedly more striate-nerved and acuminate, also the capsules are relatively more subglobose and the seeds larger. Perhaps the most evident feature of contrast between the two plants is in color, the rather deep green of *S. arenicola* producing a very different general effect from the very pale glaucous-green of *S. Atlanticum*.

It should also be noted that the flowering period of *S. arenicola* is considerably later than that of *S. Atlanticum* or *S. graminoides*.

Sisyrinchium intermedium

Dull green, sometimes not even glaucescent, turning dark in drying, the spathes purple or occasionally green: tufts not fibrous at base, 15–35 cm. high, the stems often numerous, the clustered roots numerous and slender: leaves erect, about half the height of the tufts, 1.5–2.5 mm. wide, attenuate and cuspidate-acute, thin and grass-like, the delicate nerves usually with a fainter alternating series, the tissue between minutely cellular-puncticulate, the edges minutely serrulate or even subciliolate-serrulate to smooth; young leaves sometimes roughened on the sides with minute points: stems very straight, frail, mostly 1.5 mm. wide (1–2.5 mm.), the thin wings with closely fine-serrulate edges and nerved like the leaves, usually much broader than the very narrow raised line of the proper stem; stems in some tufts all or nearly all simple, in others mostly forked at the top into two or even three pedunculate spathes subtended by a rather longer erect bracted leaf; peduncles 3–7 cm. long, often roughened on the sides with minute points, the outer one somewhat divergently outcurved, usually slender but distinctly winged, the wings serrulate, gradually widened into the base of the spathe: spathes narrow, sometimes not wider than the stem, erect, flattened and rather sharply two-edged, the sides narrowed to the base and margined below by the ascending wings of the stem; bracts thin, glabrous, delicately nerved, the outer one on simple stems prolonged beyond the inner 8–40 mm. and sometimes three times its length, in pedunculate spathes often but little prolonged, 2–6 cm. long, obscurely or very narrowly hyaline-margined, the edges not united below; inner bract narrow, 15–20 mm. long, narrowly hyaline-margined, mostly attenuate and cuspidate-acute, rarely scarious-obtuse and mucronulate; interior scales acuminate, brownish-tinged, about ⅔ the length of the inner bract: flowers 5–6, pale blue; perianth 8–14 mm. long; stamineal-column 4–5 mm. high: capsules on slenderly exserted and flexuously spreading pedicels 17–25 mm. in length, brown, broadly subglobose, or obovoid, 4 mm. high.

Southern New Jersey to North Carolina, flowering in May and early June.

New Jersey: Gloucester Co., June 1, 1892, B. Heritage, Herb. Phil. Bot. Club.

Pennsylvania: Philadelphia, A. B. Monoy, Herb. Mo. Bot. Gard.

District of Columbia: W. M. Canby, U. S. Nat. Herb.

North Carolina: Buncombe Co., Thos. Hogg, May, 1886, Herb. Columbia Univ.; G. McCarthy, May, 1888, U. S. Nat. Herb.; May 8, 1897, Biltmore Herb.; Wake Co., May, 1896, W. W. Ashe, Herb. W. W. A.; Henderson Co., Mrs. Schoolbred, 1857, Herb. N. Y. Bot. Gard.; also two sheets without record in Herb. Mo. Bot. Gard., one "ex herb. Bernhardi."

A perplexing plant appearing about intermediate between *S. graminoides* and *S. mucronatum*, yet not to be correlated with either one, although in its most divergent forms, showing a near approach to both. The more branched forms, which are nearest to *S. graminoides* differ in narrower and more attenuate leaves and purple spathes, and usually also develop many simple stems bearing spathes with much prolonged outer bracts; the branches when present are mostly shorter and more slender than in *S. graminoides* and, like the younger leaves, may be roughened on the sides; the margins of the stem and leaves are also usually more definitely serrulate than in *S. graminoides.*

The opposite form in which the stems may be all simple closely simulates *S. mucronatum* but dries dark and has thinner, more broadly winged stem and larger darker capsules on flexuously spreading pedicels as in *S. graminoides.*

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Vol. VII. No. 151—(current).

Lists of titles of Contributions may be had on application.

LUCIEN M. UNDERWOOD,
Professor of Botany.

COLUMBIA UNIVERSITY,
NEW YORK CITY.

CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 164.

TWO HITHERTO CONFUSED SPECIES OF LYCOPODIUM

BY FRANCIS E. LLOYD.

[PLATE 370.]

NEW YORK
1899

[Reprinted from the BULLETIN OF THE TORREY BOTANICAL CLUB, 26: 559–567. 15 Nov., 1899.]

Two hitherto confused Species of Lycopodium

By Francis E. Lloyd

[Plate 370]

While botanizing during the past summer in southern Vermont in company with Dr. Marshall A. Howe, it was our fortune to come across, in an open sloping pasture, an extensive growth of a *Lycopodium*, which heretofore has been, in this country, referred to the variety *chamaecyparissus* of *L. complanatum*. Associated with it, and also growing in abundance was *L. complanatum*, and the very great difference in the appearance of the two plants, both as to color and habit, at once attracted our attention. Further field observation revealed the fact that the so-called variety differed from *L. complanatum* in several important details both morphological and physiological, the position of the rhizome among others. In *L. complanatum* this runs along the surface of the ground and is flattened above, develops chlorophyll in response to its exposed position, and has narrow leaves which curve upwards, while the rhizome of *L. chamaecyparissus* is strictly underground, buried to a depth of 2–4 centimeters, a fact which Dr. Howe and I sufficiently verified by digging up the new rhizomatous growths out of the tough sod at the periphery of the area covered by the colony, and which I have myself verified in many individuals subsequently found near Cold Spring, Long Island. The rhizome of this plant is, moreover, supplied with lanceolate to ovate leaves which are contracted at the base, and is white, except when, as is sometimes the case, the plant is forced out of its normal direction by hard

[Issued 15 November.]

obstacles, thus becoming exposed to the light. This difference of habit in respect to position was also recorded by C. F. Austin in a note in his writing attached to the sheet upon which is mounted a specimen of *L. chamaecyparissus* collected by him in Bergen county, New Jersey.

Another very pronounced and quite constant difference is the habit, on the part of *L. chamaecyparissus*, of producing annual growths at the ends of the branchlets. These new growths are more or less orthotropic, according as the habitat is exposed or shaded, and usually make angles with the earlier growth. This is especially noticeable as the aërial stems of the plant are frequently long and weak, allowing the weight of the foliage, which is often great, to force them out of their original vertical position, to make angles with the previous years' growths. There is thus produced a curious and distinctive habit which is in marked contrast with that of *L. complanatum* in which the branchlets are plagiotropic, and do not produce annual innovations except very occasionally, and then only short imperfect growths, which cannot at all be compared with the vigorous unfailing annual growth of *L. chamaecyparissus*.

Correlated with the more vertical habit of *L. chamaecyparissus* is the less pronounced dorsiventral character of the more distal branches and the similarity in form of their leaves. Here the leaves of the morphological under side of the branches are scarcely different in their amount of development from those of the upper side, while in *L. complanatum* they are so reduced that only their apices, abruptly spreading from the concave lower side of the branchlet, remain in evidence. This spreading character is common to all the leaves of *L. complanatum* while in *L. chamaecyparissus* the apices of the leaves of the lateral and under rows are appressed, so much so that those of the leaves of the lateral rows curve in underneath the flattened lower side of the branchlet.

In addition to these external leaf characters is to be added the glaucous character of *L. chamaecyparissus*, as compared with the absence of this character in *L. complanatum*. have noticed that specimens of the former plant keep their moisture some time longer than do specimens of the latter, though I cannot give precise data on this point.

Nor are the differences wholly confined to the external and therefore more readily observable features, for an examination of transverse sections of the branchlets shows that the parenchyma beneath the lower epidermis is made up in *L. chamaecyparissus* of elongated cells of columnar form with oblique ends, similar but a little broader than those beneath the upper epidermis. This similarity in tissue is carried also into the epidermis, the cells of which, both on the upper and lower sides are nearly of the same size and have lumina of equal proportions. In *L. complanatum*, however, the parenchyma of the lower part of the branchlet is made up of globular cells, while those above are columnar. Here, too, we find that the cells of the upper epidermis have lumina much more reduced than do those of the lower. (Pl. 370, figs. 9, 10, 11 and 12.) The sclerenchyma sheath is also more strongly developed in *L. chamaecyparissus.*

Furthermore, there is a disparity in the time at which the spores ripen, a fact also not unnoticed by Austin, who records that in Bergen county, New Jersey, the spores of *L. chamaecyparissus* ripen "from one to two months earlier than in the type" that is, *L. complanatum.* Even in Vermont, where such phenomena are compassed in a shorter time, and where these observations were made, there is a difference of at least three weeks to a month in the time of spore-ripening. This act must be one of considerable importance.

In the light of the above facts it seems strange that these two plants have been regarded by several botanists as not deserving of separate specific rank, though it is interesting to know that the veteran Alexander Braun so regarded them and that Dillenius* fully appreciated their differences, as is evidenced by his excellent figures. It appears from descriptions and specimens that the two plants are found abundantly in Europe and have been repeatedly observed growing together. In this connection Luerssen† observes: "The two plants (*i. e.*, *L. complanatum* and var. β *chamaecyparissus*) in these extreme forms appear so different, that they might well be regarded as distinct species. They pass, gradually, however, through intermediate forms, from one to the other." This experience seems, however, not to be duplicated on this side of the Atlantic, for a careful search over an acre of ground in which a large number of colonies of both species were growing together, often intermixing, failed to discover anything at all to support this view. The two plants, growing on the same spot with their rhizomes crossing, were completely distinct. It would be of value if the botanists of this country to whom the opportunity may come, would make observations bearing on this matter. It may be added that certain European botanists appear to entertain no doubt as to the specific distinction of the two plants.

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* Hist. Musc. pl. 59 (*L. complanatum*) and 60 (*L. chamaecyparissus*). 1741.

† Rabenhorst, Kryptogamen-Flora. Farnpflanzen, 1: 825.

The attempt was made by the writer to find what differences, if any, existed between the spores, but without any very positive results. The spores of European specimens as well as from the United States were examined, and as much variation appears to exist between individual spores of *L. complanatum*, as between the spores of *L. clavatum* and either o these here under consideration. On the whole, however, there is a larger unreticulated area on the inside facets of the spores of *L. chamaecyparissus*, while the angles of the reticulations appear to be thickened in *L. complanatum.* I have not, however, been able to apply these criteria with unfailing certainty, so that I hesitate to assert that any value should be attached to them. There are slight differences, also, in the shape of the sporophylls, which in *L. chamaecyparissus* are usually more abruptly contracted beneath the apex than in *L. complanatum.*

LYCOPODIUM CHAMAECYPARISSUS A. Br.

Rhizomes extensively creeping 2–4 cm. below the surface of the ground, occasionally forced by obstructions to grow upward, but turning down again when the obstruction is passed, in color white, terete, sparingly branched in the horizontal plane, their whorled or loosely spirally arranged leaves lanceolate or ovate to broadly ovate (1–2 mm. broad), usually the latter, and then scarious, abruptly contracted into a narrow base, acute, their margins membranous and erose; the primary aërial shoots weak, terete, usually sinuously bent and often becoming decumbent under the weight of the superadded foliage, the axis repeatedly forking until it forms a mass of more or less vertically placed somewhat flattened branchlets which are plano-convex in transverse section, 1.5–2 mm. broad (concave beneath on drying); the terminal branchlets regularly producing more or less orthotropic innovations the second and sometimes the third season, the lower and therefore older foliage branches ultimately spreading and becoming lax, some of the medially placed branches remaining short, thicker, terete, strictly vertical, and producing either additional foliage parts or ultimately running up into strobile-bearing peduncles: leaves of the primary aërial axis in 6–8 rows, those at the base of the shoot similar to those of the rhizome, appressed, passing higher up the axis from ovate through lanceolate-acute into the acuminate form; those of the subterminal and terminal branchlets in four rows, an upper, an under and two lateral, glaucous, bluish green, acuminate, appressed, those of the under row differing scarcely at all from those of the other three rows, the leaves of the lateral rows somewhat incurved underneath, all becoming shorter and more crowded towards the end of the season's growth: peduncles terete, glaucous, 50–60 mm. long to the first forking, usually twice forked, the second 8–18 mm. distant from the first, spreading and curving upward, the leaves on the peduncle and its branches spirally scattered or less commonly loosely segregated into whorls of threes, spreading-acuminate, scarious-tipped; strobiles, two, three or usually four, 20–28 mm. long, the sporophylls broadly depressed ovate, truncate at the base, the lateral margins variously toothed, suddenly contracted into a subulate scarious tip; sporangium reniform, opening by a transverse slit along the top; spores deep yellow in mass, regularly areolate on the convex face, the areolae on the triangular inner faces becoming larger, more irregular and fading away so as to leave a triangular smooth area in the internal angle, ripening early in August. (*f. 2, 3, 6, 8, 11, 12, 16, 17.*)

The aërial parts reach a maximum height of about 22 cm. exclusive of the spore-bearing parts which project an additional height of 5–7 cm. above the general level of the foliage. The color is light bluish green, and glaucous throughout except on the aged lower branches, from which the waxy layer is worn away.

Found by Dr. M. A. Howe and myself growing on a sunny slope, where the plants made very dense masses of foliage with vertically placed branchlets. Newfane, Vt., July–August, 1899. Specimens found later (Oct. 14, 1899) by myself, on the hills near Cold Spring Harbor, Long Island, N. Y., which were growing in the shade, and which were very much less vigorous than the Vermont material, have looser foliage, the branchlets of which do not stand vertically, though they do turn upward at the ends, and the innovations grow upward. The variation in position may be regarded as a response to different light influences. This series also includes a single weak plant with widely spreading leaves, curiously mimicking a seedling of *Juniperus Virginiana.* The above material is all in the herbarium of the New York Botanical Garden.

Other herbarium material has been examined as follows:*

CONNECTICUT: New Haven, 1858, *D. C. Eaton* (GC.).

DELAWARE: near Iron Hill, Aug. 21, 1894, *A. Commons and E. Tatnall* (C.). Latrobe Canal feeder, 2 miles west of Iron Hill, Aug. 5, 1895, A. Commons (G.).

DISTRICT OF COLUMBIA, July, 1879, *L. F. Ward* (N.).

GEORGIA: Tallulah Falls, Apr. 19, 1891, *L. M. Underwood,* no. 2550a (U.).

MAINE: Mt. Desert, Sept. 5, 1891, *T. G. White* (C.). Mt. Desert Island, July 9, 1890, *John H. Redfield* (U.). Aroostook Co., St. Francis, dry woods, Aug. 9, 1895, *M. L. Fernald,* no. 217 (C. N. G. U.). Orono, "dry woods," Oct. 13, 1890, *M. L. Fernald* (G.).

MARYLAND: Bladensburg, July 20, 1879, *L. F. Ward* (U.); 1880, *L. F. Ward* (N.).

MASSACHUSETTS: Essex Co., *Oakes* (C.).

MICHIGAN: Near Alpena, July 11, 1895, *C. F. Wheeler* (G. N. C.). Sand dunes, Lake Huron, Huron Co., Aug. 5, 1896, *Charles A. Davis* (N.). Keweenaw Co., *Robbins* (G.). Keweenaw Co., "woods and fields," Aug., 1890, Sept., 1889, *O. A. Farwell,* no. 746 (G.).

MINNESOTA: Lake Kilpatrick, Caseo Co., July, 1893, *C. A. Ballard* (N.).

NEW HAMPSHIRE: "old clearings," Jaffrey, July 15, 1897, *B. L. Robinson* no. 225 (G.).

NEW JERSEY: Bergen Co., *C. F. Austin* "stems running rather deep (2–4 inches) in the ground. Of a more slender habit and generally with more numerous spikes than the typical form from which it is readily distinguished when they grow side by side by its shedding its spores 1–2 months earlier (in Aug.) and by its spikes turning saffron yellow. I have never found it except in shady places" (G.).

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* The letters C, G, N, U and Y indicate the Columbia, Gray, National, Underwood and New York Botanical Garden herbaria, where the cited specimens may be consulted.

NORTH CAROLINA: mountains, Waynesville, Sept. 1896, *S. M. Huger* (C.).

PENNSYLVANIA: Tobyhanna, Pocono Mt., Aug. 20, 1887, *N. L. Britton*. (C.).

VIRGINIA: Clifton, Oct. 12, 1884, *L. F. Ward* (U.).

LYCOPODIUM COMPLANATUM L.

Rhizomes extensively creeping along the surface of the ground, exposed or in moss, etc., usually green, flattened above, furrowed on the flattened surface, sparingly branching in the horizontal plane, spirally arranged or sometimes loosely segregated in whorls: their leaves lanceolate, acuminate, scarious-tipped, the lateral ones curving upward; primary aërial shoots strong, flattened and furrowed on one side, the branches convex on the upper side, concave below (1.8–2.5 mm. broad), spreading out into a horizontal plane, the medially placed branches more nearly terete, and either producing additional foliage-bearing shoots or, ultimately, sporangium-bearing peduncles: leaves of the vertical axes spirally placed or in loose whorls, spreading, acuminate, scarious-tipped, the several (5–8) rows being reduced to four on the foliage branches; the leaves of the upper and lateral rows, which are separated as by a continuous furrow, cuspidate, with spreading apices, bright green, those of the under row reduced to slender, curved, spreading, cuspidate apices, the under side of the branchlets thus appearing devoid of foliage, lighter in color and concave; all the leaves decreasing gradually in size from the base to the tips of the branches: peduncles (5–7.5 cm. long up to the forking) terete, a little stouter than in *L. chamaecyparissus*, furrowed, forking usually twice, the first and second forks 2–5 mm. distant from each other: pedicels straight, 5–8 mm. (mostly 7–8 mm. long), bearing strobiles 15–25 mm. long: leaves of the peduncles and pedicels scattered or loosely whorled in threes, acuminate, scarious-tipped, spreading: sporophylls broadly ovate, more or less toothed on the lateral margins, contracted gradually into a scarious apex: sporangia reniform, opening by a transverse slit: spores reticulate on the four faces, ripening late in August and in September. (*f. 1, 4, 5, 7, 9, 10, 13, 14, 15.*)

CONNECTICUT: West Goshen, Aug., 1889, *L. M. Underwood* C. U.). Greens Farms, Aug. 25, 1894, *C. L. Pollard*, no. 233. An abnormal condition with asporogenous spikes (N.). Derby, July 7, 1895. "Dry woods, common," *E. H. Eames, M.D.* (N.).

DISTRICT OF COLUMBIA: Near the Sligo, north of Takoma, July 10, 1895, *C. L. Pollard*, no. 467 (N.).

INDIANA: Fern, Putnam Co., Oct., 1892, *L. M. Underwood* (U.).

MAINE: Anson, July 9, 1885, *T. F. Collins*, "Fertile" (G.).

MASSACHUSETTS: Essex Co., *William Oakes* (C.). Mt. Toby, near Amherst, July 27, 1895, *Mrs. A. F. Stevens* (N.); 1871, *Dr. Palmer* (N.). Benjamin Hill, near Winchendon, Worcester Co., Sept. 3, 1895, *C. L. Pollard* (N.). Concord, "woods around Walden Pond," Sept. 30, 1879, *W. P. Rich* (G.). Concord, Nov. 1, 1890, *L. M. Underwood* (U.). A form with six strobiles on the peduncle and more distant forkings, Northfield, July 5, 1890, *F. E. Lloyd* (Y.). Williamstown, Oct., 1891, *F. E. Lloyd* (Y.).

MARYLAND: near Signal Tree Heights, between Washington and Silver Spring roads, Oct. 7, 1893, *Adam Steitz* (N.). Spencerville, July, 1891, *J. M. Holzinger* (N.).

MINNESOTA: Soudan, St. Louis Co., 1896, *J. H. Ely* (C.). Duluth, July 26, 1889, pine woods, 16 miles west of Duluth (N.).

NEW HAMPSHIRE: southern "woods common," July 9, 1897, *B. L. Robinson*, no. 187 (G.). Seabrook, 1894, *Alvah Eaton* (with abnormal forking spikes) (U.). Benton, July 4, 1890, *S. F. Tower*.

NEW JERSEY: Clifton, Sept. 23, 1894, *T. H. Kearney, Jr.* (C.). Bergen Co., "matures its spores in September and October," *C. F. Austin* (C.). Bergen Co., "a variety with short rigid leaf-branches and numerous short spikes," *C. F. Austin* (C.). Stockholm, "swamp, 1100 ft. alt.," Aug. 1–15, 1895, *Wm. M. Van Sickle* (N.).

NEW YORK: Tannersville, Greene Co., Oct. 6, 1891, *A. M. Vail* (C.). "Dry copse, near woodland, common," Nov. 28, 1890, *R. Kenyon* (N.). Cold Spring Station, Long Island, in deep woods, Oct. 14, 1899, no spikes found, *F. E. Lloyd* (Y.). Morrisville, Oct., 1878, *L. M. Underwood* (U.). West Camden, 1897, *Arma A. Smith* (U.).

ONTARIO: Gun Flint Lake, July 18, 1891, *F. F. Wood* (N.).

PRINCE EDWARD ISLAND: Cantire, Sept. 3, 1883, *John Macoun* (C.).

QUEBEC: Notre Dame du Lac, Termiscouata Co., Aug. 2, 1887, *John I. Northrop* (C.).

VERMONT: Willoughby Lake, Aug. 22, 1895, *Mrs. G. F. Stevens* (N.); Willoughby, July 26, 1892, *H. H. Rusby* (C.); Newfane, July–Aug., 1899, *M. A. Howe and F. E. Lloyd* (Y.).

WEST VIRGINIA: South Fork of Holston River, Smyth Co., June 15, 1892, *N. L. and E. G. Britton and A. M. Vail* (C.).

Explanation of Plate 370

The figures were drawn from specimens collected near Newfane, Vt., growing in the same habitat. Figures 3–8 were drawn to the same scale × 9, as were also figures 9–12 and 13–17.

FIG. 1. *Lycopodium complanatum;* upper part of aërial shoot bearing two peduncles, only one of which is shown. × ⅔.

FIG. 2. *Lycopodium chamaecyparissus;* upper part of aërial shoot. In this particular plant the peduncle does not extend as far as it does normally above the general level of the foliage. The terminal branchlets can be seen to make definite angles with the subterminal, previous year's growth. × ⅔.

FIGS. 3, 6, 8. Upper, under and lateral views respectively, of a part of a branchlet of *Lycopodium chamaecyparissus.*

FIGS. 4, 5 and 7. Upper, under and lateral views respectively, of a part of a branchlet of *Lycopodium complanatum.*

FIGS. 9 and 10. Portions of the epidermis and subjacent parenchyma from the upper and under sides respectively, of a branchlet of *Lycopodium complanatum.*

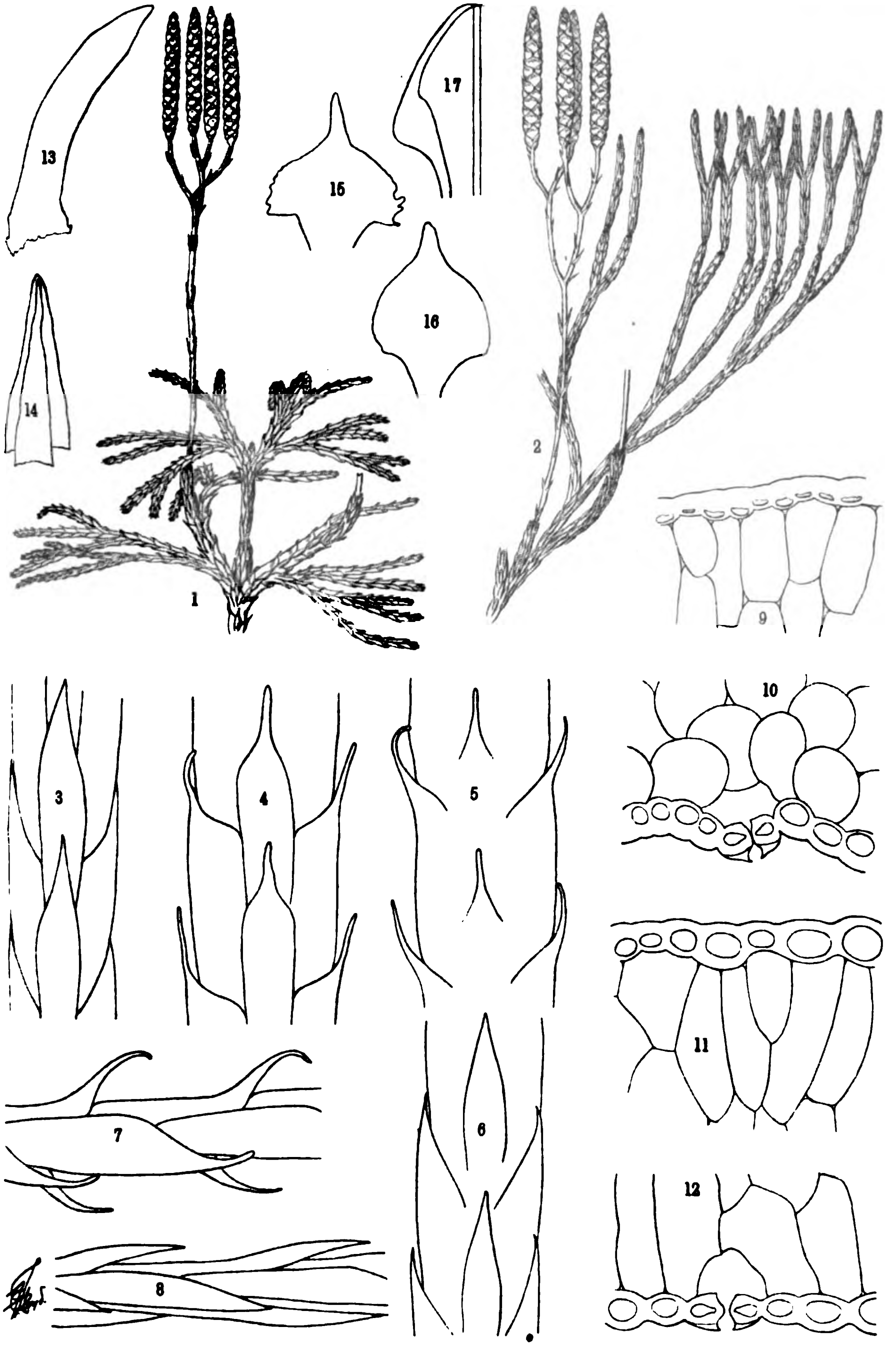
FIGS. 11 and 12. The same of *Lycopodium chamaecyparissus.*

FIGS. 13 and 14. Outlines of scales from the rhizome of *Lycopodium complanatum.*

FIG. 15. Sporophyll of *Lycopodium complanatum.*

FIG. 16. Sporophyll of *Lycopodium chamaecyparissus.*

FIG. 17. Half-outlines of scales from the rhizome of *Lycopodium chamaecyparissus.*



LLOYD ON LYCOPODIUM.

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LUCIEN M. UNDERWOOD,
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COLUMBIA UNIVERSITY,
NEW YORK CITY.

CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 165

A REVISION OF THE NORTH AMERICAN SPECIES OF SCLEROPODIUM

BY A. J. GROUT

NEW YORK
1899

[Reprinted from the BULLETIN OF THE TORREY BOTANICAL CLUB. **26**: *531-540*. 16 Oct., 1899.]

A Revision of the North American Species of Scleropodium

By A. J. Grout

SCLEROPODIUM Br. & Sch. Bry. Eur. 1853

Closely allied to *Brachythecium* and included in it by some authors; differing slightly in the general habit and in the julaceous branches with concave, often obtuse leaves; leaf cells very long and narrow, 10–20 : 1. Stem leaves abruptly and slenderly acuminate in most species. Seta rough; capsule as in *Brachythecium*. All of our species are western. *S. illecebrum* and *S. caespitosum* are also European.

1. **Leaves broadly ovate to suborbicular, without pointed apex or at most short-cuspidate; auricles distinct, consisting of plainly dilated cells; aquatic.** *S. obtusifolium.*
   Leaves ovate to lanceolate; stem leaves slenderly acuminate, without distinct auricles; terrestrial. 2.
2. **Leaf cells 14–18 : 1, differentiated basal and alar cells few.** 3.
   Leaf cells 7–12 : 1, differentiated basal and alar cells in several rows. 4.
3. **Branch leaves ovate-lanceolate to lanceolate, acute to acuminate; capsules suberect and nearly symmetric.** *S. colpophyllum.*
   Branch leaves ovate to oblong-ovate, obtuse to abruptly short-acuminate; capsules horizontal and unsymmetric. *S. illecebrum.*
4. **Branches slightly julaceous; capsules suberect and nearly symmetric.** *S. caespitosum.*
   Branches strongly julaceous; capsules more arcuate and unsymmetric. *S. apocladum.*

This genus is perhaps too near *Brachythecium* and one species referred to it by most authors (*S. Californicum*) is most certainly a *Brachythecium*. The relationship with *Eurhynchium* is much more distant and Sullivant's reference of *S. colpophyllum* to that species is hard to understand when one has a large series of plants for comparison. The relationship between *S. colpophyllum* and *S. caespitosum* is so close that about half the specimens of the former in American herbaria have been referred to the latter.

I am greatly indebted to the United States National Museum, Harvard University, The University of Wisconsin, and Mr. J. M. Holzinger for the loan of specimens. The work has been largely done at the Herbarium of Columbia University and was made possible by the kindness of Prof. Underwood and Mrs. Britton.

SCLEROPODIUM ILLECEBRUM (L. *p.p.*) Br. Sch. Bry. Eur. *pl.* *557.* 1853

Muscus terrestris surculis kali geniculati aut illecebrae, aemulis etc. Vail. Botan. Paris 137, *pl.* *25. f. 7.* 1727.

Hypnum illecebrum L. *p.p.* Sp. Pl. 1129. 1753.

Hypnum Touretii Brid. Sp. Musc. **2**: 185. 1812.

Hypnum illecebrum Schwaegr. Suppl. **1**, part 2: 225. 1816.

Hypnum blandum Lyell in Hook. & Tayl. Musc. Brit., Ed. 2: 176. 1827. Suppl. *pl.* *5.* 1827.

Gametophyte in wide spreading mats, varying from dirty green to bright glossy green: stems 3–10 cm. long, creeping, irregularly divided, irregularly or often subpinnately branching, partially denuded of leaves in the older portions, sparingly radiculose, younger portions ascending and much like the branches: branches short, rarely reaching 1 cm. in length, julaceous, turgid, ascending to erect, more or less arcuate, usually obtuse: branch-leaves appressed imbricate when dry, erect open when moist, varying greatly in shape; those from the middle of the larger branches broadly ovate to oblong-ovate, 1.2×0.6 mm., abruptly narrowed to a short point, finely and sharply serrate above, sometimes nearly entire, very concave, slightly sulcate when dry, smooth when moist, not decurrent but half clasping, acumination of leaves often squarrose-spreading when dry; costa extending ¾ the length of the leaf, sometimes ending in a dorsal spine; median cells linear-vermicular, 0.005 mm. wide and 12–18 : 1, apical much shorter; basal subquadrate, colored and thicker walled; alar somewhat larger and less deeply colored; leaves of the shorter branches and upper and lower leaves of the longer branches often lack the acumination and are obtuse or obtusely acute: stem leaves averaging larger, in robust plants reaching 2.3×1 mm., gradually tapering to a longer acumination, nearly or quite entire, those of the younger stems scarcely to be distinguished from the branch leaves. Dioicous: perichaetial leaves oblong-lanceolate, gradually narrowed above to a slender entire or subdenticulate acumination, faintly costate, acumination less slender than in *S. caespitosum.*

Sporophyte 1–2 cm. high: seta greenish brown, becoming red brown with age, twisted to the right, very rough with large papillae: capsule a little lighter colored than the seta, horizontal, unsymmetric or arcuate, with operculum 2.5 mm. long, 2.5–3 : 1; operculum long-conic, acute; annulus of two rows of cells, easily deciduous; teeth united at base, nearly colorless and papillose above; segments nearly as long as the teeth, finely papillose, from basal membrane equaling two fifths the length of the teeth; cilia 2, well developed, appendiculate; spores nearly smooth, maturing in winter.

Forma *pinnatifidum* from California in the Gray Herbarium at Harvard is more slender and nearly regularly pinnate.

Type locality, France near Paris. Type at Paris.

On shady grassy soil and on shaded rocks.

California, Idaho, Washington, British Columbia, Vancouver.

EXSICCATI: Sulliv. & Lesq. Musc. Bor.-Am., Ed. 2, 508.

ILLUSTRATIONS: Bry. Eur. *pl. 557;* Husnot, Musc. Gall. *pl. 95;* Dixon & Jam. Handb. Brit. Mosses, *pl. 53, G;* Limpricht, Rab. Krypt. Fl. **4**: *f. 378.*

The robust habit, julaceous turgid branches, and thick unsymmetric horizontal capsules make this species easy to recognize when typical. It grades insensibly into *S. obtusifolium* and it is often very hard to say to which species certain forms should be referred.

SCLEROPODIUM OBTUSIFOLIUM (Hook.) Kindb. Cat. Can. Pl. **6**: 202. 1892

Hypnum obtusifolium Hook. Drumm. Musc. Am. no. 193.

Hypnum arcticum var. Muell. Syn. **2**: 432. 1851.

Stereodon obtusifolius Mitt. Journ. Linn. Soc. **8**: 42. 1865.

Gametophyte submerged or nearly so, attached to stones in brooks, light green above, brown below: stems irregularly branching, naked below and roughened by the leaf bases of the fallen leaves; young stems and branches julaceous; branches 5–20 mm. long: leaves close imbricate and appressed when dry, more open when moist, broadly ovate to suborbicular, very concave, spoon shaped, round-obtuse, without acumination or very shortly cuspidate, 1.2 × 1 mm., not plicate or sulcate except under pressure, entire or faintly denticulate near apex; costa stout, extending five sixths the length of the leaf; median leaf cells linear vermicular, 0.05–0.065 mm. long, 8–10 : 1; apical cells broader and shorter, 2–3 : 1; alar cells rather abruptly enlarged to form distinct auricles, 0.013 mm. long, 3 : 1.

Type from rivulets in the Rocky Mts., Drummond. Type not seen, probably at Kew.

Described from Drummond's Musc. Am. 193, which is sterile.

California, Nevada, Idaho, Montana, Washington, Oregon, British Columbia.

EXSICCATI: Macoun's Canadian Musci 359 is very much larger and in every way more robust than the type, but has all of the distinctive microscopic characters. The same is true of Renauld and Cardot's Musc. Sept. Exs. 111. Sullivant and Lesquereux, Musc. Bor.-Am., edition 2, no. 509 (*Hypnum illecebrum* var.), is fairly representative of the species and bears the mature sporophyte, which differs little from that of *S. illecebrum.* The capsule is a little shorter and there are sometimes as many as four strongly nodose cilia in the endostome: the seta is exceedingly rough with very high papillae: operculum short rostrate when dry.

There can be no doubt that this should be regarded as a subspecies of *S. illecebrum.* The plants nearest the type are always submerged and nearly always sterile. A complete series can be traced from the typical form described above to typical *S. illecebrum.* M. Cardot in Hedwigia **32**: 345. 1893, states that he has come to the conclusion that *S. obtusifolium* is a water form of *S. illecebrum* and states that the latter varies greatly in the characters which separate the two species. He also states that he has found these variations in the same tuft. It seems probable, however, from what he says that he had at hand specimens of the more common form of *S. obtusifolium*, which is more robust than the type or than *S. illecebrum* itself. Drummond's 193 is less robust than *S. illecebrum.*

M. Cardot also informs me that he and M. Renauld first suggested to Prof. Kindberg that *Hypnum obtusifolium* is a *Scleropodium.* This fact Prof. Kindberg failed to acknowledge in his publications.

Dr. M. A. Howe has côllected specimens on moist, shady banks at Berkeley, California, June 28, 1894, that have the leaf characters of the typical form, except that the leaves are longer in proportion to their width. This goes to show that the submerged growth is not the cause of the inflated alar cells, shorter leaf cells and more concave leaves.

In some cases the plants are flaccid with more distant, less closely appressed leaves constituting forma *laxum.*

A form from Goldstream, Vancouver Island, Macoun, May 18, 1887, has erect branches 3–4 cm. long, strongly curved at the ends, bearing suborbicular, strongly secund leaves 2 mm. in length. For this I suggest the name var. *homomallum*. This variety is the extreme development of the robust form while the typical form is at the other extreme.

Scleropodium apocladum (Mitt.)

Hypnum apocladum Mitt. Journ. Linn. Soc. 8: 35. 1865.

Gametophyte in wide interwoven mats of medium thickness, light green above, dirty green below the surface, somewhat resembling *Eurhynchium strigosum praecox* in appearance: stems creeping, 1–4 cm. long, irregularly branching: branches often fascicled, simple or sparingly divided, 3–8 mm. in length, julaceous, attenuate: branch leaves appressed-imbricate when dry, those on the branches below the surface of the mat erect spreading, ovate, acute to short-acuminate, scarcely decurrent, slightly serrulate at apex, otherwise nearly entire in the type, other specimens finely serrulate nearly to the base, somewhat concave, not plicate or sulcate; costa extending at least four fifths the length of the leaf, stout; median cells linear-oblong, 7–9: 1; quadrate basal and alar cells very numerous; apical cells broader and shorter; the leaves near the apex of the branches narrower and more longly acuminate: leaves of creeping stems variable in shape, semiorbicular and abruptly short-acuminate to ovate and longer acuminate. Perichaetium 4.5 mm. long, the inner leaves long lanceolate, long and slenderly acuminate, slightly serrulate, some faintly costate (Mitten says "nerved to above middle"). Sporophyte about 12 mm. high: seta red-brown, in the type plainly papillose with low distant papillae, in other specimens strongly roughened: capsule red-brown, about 2 mm. long, 3–4: 1; "suberect, oval cylindrical," in other specimens inclined to horizontal, unsymmetric; operculum conic-apiculate; annulus of two rows of cells; segments nearly as long as the teeth, split between the articulations; cilia two, strongly appendiculate; spores smooth, 0.013 mm.

A fragment of Mitten's type from "The Northwest Coast, Douglas" has been accessible, and a specimen from the United States National Museum collected at Pasadena, California, by Dr. Palmer, and determined as *S. caespitosum* has been carefully compared with this fragment. The two agree in all essential particulars. The leaves of Dr. Palmer's specimen are more acuminate and more serrulate, the seta is rougher and the capsule more unsymmetric and inclined, but these differences are no greater than frequently occur in individuals of the same species. The seta in the type is much rougher than the original description would lead one to expect.

The leaf cells are much shorter than in most species of the genus, but in all other particulars it seems closely related to the other species.

Type in Mitten Herbarium.

SCLEROPODIUM CAESPITOSUM (Wils.) Br. & Sch. Bry. Eur. *pl. 556.* 1853

Hypnum caespitosum Wils. English Bot. Suppl. *pl. 2878.* 1849. Also Bry. Brit. 344. *pl. 55.* 1851.

Hypnum caespitans C. Muell. Syn. **2**: 354. 1851.

Eurhynchium colpophyllum flagelliforme Barnes, Bot. Gaz. **16**: 207. 1891.

Gametophyte in rather thin loosely interwoven mats, light or dirty green: stems creeping, 5–10 cm. long, irregularly divided and branching; branches usually longer and more slender than in *S. illecebrum*, tapering, sometimes julaceous, but less frequently so than in *S. illecebrum:* branch leaves, from the middle of the branches 0.9–1 × 0.3–0.4 mm., ovate to oblong-lanceolate, usually tapering and acute at apex but sometimes nearly as obtuse as in *S. illecebrum*, appressed and imbricate to erect-open when dry, concave, scarcely plicate when moist, not decurrent, finely serrate at apex; median cells narrowly linear-vermicular, 8–12 : 1; quadrate basal cells in several rows, alar little differentiated from the other basal cells; apical cells broader and shorter; costa stout, frequently forked, extending three fourths the length of the leaf, often ending in a spine at the back of the leaf; stem leaves ovate to ovate-lanceolate, slenderly acuminate, with a larger number of short basal and alar cells, alar cells somewhat enlarged at the decurrent angles. Dioicous; inner perichaetial leaves loosely sheathing at base, gradually narrowed to a long subfiliform and suberect acumen, distantly and slightly denticulate above or sometimes entire, faintly costate.

Sporophyte 10–15 mm. high: seta red-brown, twisted to the right, very rough: capsule light brownish-green, oblong cylindric, suberect, slightly unsymmetric, with operculum 2–2.5 mm. long, about 2.5 : 1; operculum conic-apiculate to conic-rostellate, often appearing short rostrate when dry; annulus of two rows of cells, deciduous; teeth of peristome slender, subhyaline and slightly papillose at apex; segments nearly as long as the teeth, yellowish, more strongly papillose, from a wide basal membrane and widely open between the articulations; cilia two, very strongly nodose; spores rough, about .016 mm., maturing in winter.

Type locality, Langford, near Warrenton, England.

Growing on stumps and old logs, roots of trees and rocks. California, Washington, Oregon, Vancouver Island, Lake Athabasca (Macoun), Alaska (Kellogg).

ILLUSTRATIONS: See above; also Dixon and Jameson, *pl. 153, B;* Husnot, Musc. Gall. *pl. 115.*

EXSICCATI: As *Hypnum caespitosum;* Sull. & Lesq. Musc. Bor.-Am. 510; Macoun, Can. Musc. 290 (In part only. See under *S. colpophyllum.*)

Sterile and robust *S. caespitosum* is hard to distinguish from *S. illecebrum.* In general it is more slender, less frequently julaceous with closely imbricated leaves, with tapering branches and narrower more gradually tapering leaves having their median leaf cells longer and rather narrower and the differentiated basal cells more numerous. It also comes very close to slender forms of *S. colpophyllum.*

Sullivant and Lesquereux's exsiccati (*l. c.*) do not agree very closely with Wilson's Musc. Brit. 349, or with the plate in the Bryologia Europaea. The stem leaves are too abruptly acuminate with too short an acumen. This is a variation in the direction of *S. obtusifolium,* but as these characters are variable according to Wilson's own description, these specimens should probably be referred to a form of *S. caespitosum.* Dr. M. A. Howe has collected a moss on "Redwood stumps, Mill Valley, Marin Co., California, January 16, 1892," that agrees very closely with Wilson's exsiccati so that there can be no reasonable doubt of the identity of the European and American plant.

I feel quite sure that *Hypnum lentum* Mitt. Journ. Linn. Soc. **8**: 36. 1865, is at least nothing more than a variety of *S. caespitosum,* and probably is identical with it. *S. caespitosum* was very little known at the time *Hypnum lentum* was published and a careful reading of the original description will fail to show any distinctions of importance between the two. The matter cannot be definitely settled until Mitten's type is accessible.

SCLEROPODIUM CAESPITOSUM SUBLAEVE R. & C. Bot. Gaz. **15**: 61. 1890

"Pedicel nearly smooth, slightly rough only below the capsule. Oregon, Suavies Island (Th. Howell)." M. Cardot very kindly sent me a portion of this for examination. It agrees with the typical form except as noted above.

Scleropodium colpophyllum (Sulliv.)

Eurhynchium colpophyllum Sulliv. Icon. Musc. Suppl. 95. *pl. 71.* 1874.

Brachythecium colpophyllum Kindb. Can. Rec. Sci. 1894: 73. 1894.

Eurhynchium Macounii Kindb. Rev. Bryol. **22**: 85. 1895.

Gametophyte in wide, soft intricate mats, dirty green: stems creeping radiculose, about 5 cm. long, often stoloniferous, much elongated: branches numerous, erect, about 5 mm. long, terete-foliate, often julaceous: branch leaves closely imbricate when dry, erect-spreading when moist, not decurrent, oblong-lanceolate to broadly-ovate-lanceolate, 1.3–1.5 × 0.45–0.6 mm., acute or broadly acuminate, serrate above, very concave, scarcely plicate; costa extending four fifths length of leaf, ending in a spine on the underside; median leaf-cells long linear, 14–18:1; basal somewhat shorter and broader; a few of the alar cells quadrate: stem leaves triangular-ovate, long and slenderly acuminate, 1.3–1.8 × 0.8 mm. Dioicous, perichaetial leaves with sheathing bases and loosely erect open points, oblong-ovate, slenderly acuminate, costate, nearly entire.

Sporophyte about 15 mm. high: seta light brown, flexuous, twisted to the right, rough with rather distant conical papillae: capsule brown, oblong cylindric, suberect, more or less arcuate, with the operculum about 2 mm. long, 2.5–3:1; slightly constricted under the mouth when dry; operculum conic-rostrate; annulus present, of two rows of cells, easily detachable; segments nearly as long as the teeth, widely split: cilia 2, strongly nodose or subappendiculate; spores minutely roughened, 0.012–0.016 mm., maturing in autumn.

Type locality, California, Bigelow. Type in the Gray Herbarium; examined by the author.

Not rare in California, but frequently confused with *S. caespitosum*; Vancouver Island, Macoun; Alaska, Kellogg.

ILLUSTRATIONS: Sulliv., *l. c.* Evidently Sullivant did not figure any stem leaves as those on the type specimen are quite different from any in the figure in the Icones.

This species is much nearer slender-leaved forms of *S. caespitosum* than is generally recognized. It is distinguished from *S. caespitosum* by its narrower more slenderly acuminate branch leaves, which are more sharply serrate, with median cells longer and narrower, enlarged basal and alar cells much less numerous. In gross appearance the whole plant, and particularly the branches, is much longer. It is undoubtedly a derivative of *S. caespitosum* and intermediate forms are not very rare.

Type specimens of var. *flagelliforme* Barnes have the shorter median cells and the more numerous differentiated basal cells of *S. caespitosum* and seem to me to belong to that species. The slender flagelliform branches are not rare in *S. caespitosum*.

Scleropodium Macounii Kindb. was founded on Macoun's Canadian Musci no. 290. According to the statement of Professor Macoun himself, this number is made up of two collections numbered originally 33 and 212. I find that 33 in his herbarium is *S. colpophyllum* and 212 is *S. caespitosum*. I have examined several of Canadian Musci no. 290 and have found some to be *S. caespitosum* and others to be *S. colpophyllum*. This makes it reasonably sure that *S. Macounii* is a synonym of *S. colpophyllum*. Kindberg states that *S. Macounii* is "monoecious." In this I think he is mistaken, for a careful examination of one of the specimens of 290 which I referred to *S. colpophyllum* showed it to be distinctly dioicous. The male plants were, however, so closely intertwined with the female that at one time I made the same mistake, which was corrected later by a more critical study. Kindberg characterizes the branch leaves as "obtusate." As I am uncertain as to the meaning of the term I do not feel sure whether it tallies with my conclusions or not.

Scleropodium colpophyllum attenuatum var. nov.

Stoloniferous, much more slender with more distant loosely spreading leaves: leaves much narrower with a longer and more slender acumination: branch leaves varying from 1.7 × 0.54 mm. on the longer branches to 1 × 0.2 on the smaller.

Type from perpendicular rocks, Victoria, Vancouver Id., May 2, 1893, Macoun.

Type in the herbarium of the Geological and Natural History Survey of Canada at Ottawa.

DOUBTFUL AND LITTLE KNOWN SPECIES

HYPNUM LENTUM Mitt. Journ. Linn. Soc. **8**: 36. 1865 is undoubtedly a *Scleropodium* and I am confident that it is at most nothing but a variety of *S. caespitosum*. *Vide* notes under that species.

SCLEROPODIUM KRAUSEI (Muell.) R. & C. Rev. Bryol. **20**: 19. 1893.

Hypnum Krausei Muell. Flora **70**: 224. 1887.

M. Jules Cardot very kindly obtained a portion of Müller's type of *Hypnum Krausei* from the Royal Botanical Museum, at Berlin, and sent it to me for examination. In his letter M. Cardot states that it seems to him to belong rather to *Limnobium* than to *Scleropodium*. I entirely agree with this view, for the general habit, the smooth seta, and the costa frequently short and double or forked point very strongly to a close relationship with *Limnobium*.

EXCLUDED SPECIES

SCLEROPODIUM CALIFORNICUM (Lesq.) R. & C. Rev. Bryol. **20**: 20. 1893 is plainly a *Brachythecium* and was so published by Jaeger and Sauerbeck, St. Gall. Nat. Gesell. 1877–78: 326.

EURHYNCHIUM SUBCAESPITOSUM Kindb. Rev. Bryol. **22**: 84. 1895, which he puts in the subgenus *Scleropodium* in the original publication is nothing but a form of *Brachythecium asperrimum* according to specimens kindly communicated by Prof. Macoun.

The Publications of the Department of Botany, Columbia University, consist of Memoirs in quarto and Contributions in octavo.

The Memoirs already published are:—

Vol. I. **Small.** A monograph of the North American species of the genus *Polygonum*. pp. 178. 84 plates. 1895. Price, six dollars.

Vol. II. **Rydberg.** A monograph of the North American Potentilleæ. pp. 224. 112 plates. 1898. Price, six dollars.

The Contributions have now reached the seventh volume.

Vol. I. Nos. 1–25 (1886–1892). Out of print, except Nos. 6, 7, 11, 17, 20, 21, 22, 24. These can be supplied at twenty-five cents each, except No. 6, which is one dollar.

Vol. II. Nos. 26–50 (1892–1894). Nos. 26, 28, 29, 32, 33, 34, 36 39 and 48 are out of print. Other numbers can be supplied at twenty-five cents each, except No. 35, which is one dollar and a half.

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Lists of titles of Contributions may be had on application.

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 166

STUDIES IN SISYRINCHIUM—VI: ADDITIONAL NEW SPECIES FROM THE SOUTHERN STATES

BY EUGENE P. BICKNELL

NEW YORK
1899

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Studies in Sisyrinchium—VI: Additional new Species from the Southern States

By Eugene P. Bicknell

In the South Atlantic and Gulf States the genus *Sisyrinchium* has expressed itself with marked emphasis. Although not hitherto regarded as forming more than a very insignificant feature of the southern flora the group actually embraces such a number of species that it must take rank among the largest homogeneous genera of the south. These numerous species in their general near relation yet perfect distinctness call to mind especially the interesting brotherhood of species in *Eupanicum* among the grasses.

Since the publication of the first paper of this series describing some of these plants, additional material from the South has been received which reveals a further considerable number of species not hitherto suspected to exist. These come to light mainly through the important collection of the Biltmore Herbarium, kindly placed at my disposal by Mr. C. D. Beadle, and through an interesting series of specimens from the South Atlantic States forwarded by Mr. W. W. Ashe.

Including the new species here described the total number now known to me from the region south of Washington, D. C., and east of the Mississippi is thirty-four. I have no reason to doubt the perfect validity of any one of these, but, on the contrary, am well satisfied that certain of them, as *S. Carolinianum* and *S. Atlanticum*, are still aggregates and that the number of species from the Southern States will yet be materially augmented.

[Issued Dec. 22.]

The Texan species will be treated separately in a subsequent paper.

Sisyrinchium incrustatum

Dull green and slightly glaucescent, turning dark when dry, 25–50 cm. high: tufts coarsely brown fibrose at base, the slender roots much elongated. Leaves more than half the height of the stem, 1.5–3.5 mm. wide, erect, tapering to an aculeate point, rather thin but firm and chartaceous, usually harshly rugulose-scabrous between the nerves but varying from merely rugulose to densely incrustate with minute pale points, strongly close-nerved and striate, the striae below becoming prominent and pale in color, often with a lesser alternating series: stems often somewhat curved and twisted, 1.5–3 mm. wide, harsh and scabrous-rugulose like the leaves, especially the prominent wings, the edges like those of the leaves, closely ciliolate-serrulate; nodes one or two, the lower one bearing an erect and prominent often much elongated leaf and two or three peduncles, the upper one terminating an outcurved prolongation of the stem 4–9 cm. long and with a shorter bracteal leaf and mostly three shorter peduncles; peduncles often outcurved, stout or slender, winged, stiff-ciliolate, bracteal leaves harsh and striate like the lower leaves, the clasping base somewhat broadened and oppositely bicarinate: spathes erect or slightly bent, the subequal bracts 15–25 mm. long, stiff and strongly fine-striate, slenderly sharp attenuate to merely acute or the inner one apiculate from a scarious-margined apex, the outer one very narrowly hyaline-margined, smooth or obscurely scabrous-rugulose: scales silvery-brown, acuminate, more than three-quarters the length of the inner bract; flowers 4–9, violet-blue, perianth about 8 mm. long; stamineal column 4–5 mm. high; capsules dark, subglobose, 3–4 mm. high on suberect slightly exserted pedicels; seeds 1–1.25 mm. in diameter, subglobose, finely pitted.

NORTH CAROLINA: in damp or wet sandy soil or in open grassy woods, flowering in July, Forsythe Co., Winston, July, 1897, W. W. Ashe; Sampson Co., W. W. Ashe; Craven Co., July 3, G. McCarthy, U. S. Nat. Herb.

Related to *S. arenicola* and *S. xerophyllum* Greene and apparently in close affinity with *S. rufipes* although a much larger and stouter plant in every way and flowering in midsummer instead of early spring.

Sisyrinchium versicolor

Becoming 35 cm. high, pale green and very glaucous, not drying dark, the sheaths of the leaves rose-pink and the spathes mostly purplish-tinged; tufts not fibrous at base; roots slender and wiry. Leaves 1.5–3 mm. wide, close-striate, stiff, tapering to an acute point, the edges, like those of the stem mostly serrulate-roughened: stem simple or frequently developing a node with a prominent erect leaf and two peduncles, 1–2.5 mm. wide, the wings distinctly striate: spathes erect, the base narrowed downwards on the sides of the stem, the wings passing up on either side; bracts and lower part of bracteal leaf closely roughened all over with minute points, often prominently striate: outer bract much prolonged beyond the inner in simple stems, little surpassing it when the stem is branched, 2.5–5 cm. long, very acute, the narrowly hyaline margins not united below; inner bract narrow, 17–20 mm. long, often scarious and abruptly pointed at the apex: flowers pale blue, 10–12 mm. long; stamineal column about 5 mm. high: capsules on very delicate, slenderly exserted, subspreading pedicels, pale, apparently subglobose and about 3 mm. high, but not fully mature in the specimens examined.

Washington, D. C., to Georgia, flowering in May.

Washington, D. C., May 11, 1884, U. S. Nat. Herb.

NORTH CAROLINA: Raleigh, May, 1896, hillsides, W. W. Ashe, Type; Chapel Hill, W. W. Ashe.

GEORGIA: A. W. Chapman in Herb. Torr. Bot. Club.

Apparently nearest to *S. intermedium* and *S. mucronatum*, but as compared with both much paler and more glaucous with stiffer more striate leaves and stem and scabrellous bracts. The roughened bracts have much the appearance of those of the twin-spathed *S. scabrellum* or of extreme forms of the more western *S. campestre.* The latter is a lower more slender species, with always simple stems, the inner bract emerging from the outer one more abruptly and at a point much nearer the less narrowed base of the spathe.

Sisyrinchium Asheianum

Caespitose in close tufts, 20–30 cm. high, not fibrillose-coated at base, pale green and glaucescent, the leaf sheathes and spathes purplish to deep wine-purple; leaves half the height of the stem or longer, erect, 0.5–1.5 mm. wide, close-striate, smooth or sometimes roughened, tapering to a hardened acute or obtusely pointed tip: stems mostly about 1 mm. wide, the margins distinctly few-striate, the edges smooth or denticulate: spathes twin, or even three together, or in reduced stems sometimes solitary, sessile at the top of the stem and subtended by an erect bracteal leaf 2–6 cm.

long; bracts of spathes subequal, 10–16 mm. long, distinctly nerved, glabrous or slightly roughened with minute often purplish points, abruptly scarious obtuse and apiculate to attenuate; inner bract of outer spathe equaling or mostly exceeding the outer one; interior scales silvery white, from half to three quarters the length of the bracts; flowers on hair-like exserted pedicels usually subspreading from the top of the spathe; perianth deep violet-blue, 7–10 mm. long, stamineal column 4–5 mm. high: fruit not seen.

NORTH CAROLINA: Salisbury, Rowan Co., April 28, 1897, in wet meadows. Biltmore Herbarium.

Intermediate in appearance with *S. mucronatum* and *S. scabrellum* and related also to *S. albidum* and *S. capillare*. From *S. mucronatum* it is distinguishable at once by its geminate spathes without regard to other characters. *S. albidum* differs in brighter green color, broader, softer and less striate leaves and stem, larger spathes with the broader base passing more abruptly across the sides of the stem and with the bracts greener and more herbaceous and attenuate, less exserted pedicels, paler or white and larger flowers. *S. capillare* is altogether more slender and delicate, and differs further in fibrillose-coated base, merely margined stem, and smaller spathes having narrower more attenuate bracts broadly white hyaline on the margins.

S. Asheianum clearly bears a very close relationship to *S. scabrellum* but is mostly a much lower plant with narrower leaves and stem, less slender roots, more highly colored bracts which are much less herbaceous and attenuate, and smaller, deeper blue flowers; it is moreover either quite glabrous throughout or with only obscure indications of the scabrellous investiture of bracts and leaves which is so noteworthy a character of *S. scabrellum*. The latter, as recorded on collectors' labels, is a plant of dry woodlands, *S. Asheianum* of wet meadows.

Named for Mr. W. Willard Ashe, whose collection of southern *Sisyrinchia* has furnished several new species and who was himself about to publish as new the plant here described.

Sisyrinchium capillare

Extremely slender and delicate, growing in erect thin tufts 20–45 cm. high, closely erect-fibrillose at base; glaucescent, drying a dull olive-green, the spathes and leaf-bases often tinged with pale dull purple; roots slender and wiry. Leaves from half to three quarters the height of the stems, closely erect, almost filamentary, mostly .05 mm. or less wide and strongly 2–4-striate, very smooth, attenuate-acute, in age often developing hardened tips: stems equally slender with the leaves, wiry and subterete, not winged but narrowly firm-margined, the edges smooth: spathes mostly two or sometimes single, rarely three together, sessile at the top of the stem and closely subtended by an elongated primary bract, very small, 10–13 mm. long, the bracts subequal, mostly very acute or aculeate, somewhat membranous but distinctly nerved, glabrous, the margins conspicuously white-hyaline; primary bract straight and setaceously slender, usually much elongated, 2–8.5 cm. long, the edges narrowly white-hyaline towards the striate base which is on both sides rather abruptly broader than the stem; interior scales silvery-white, usually but little shorter than the bracts: flowers light violet-blue on slenderly exserted, loosely erect, or finally flexuously spreading pedicels; perianth 6–8 mm. long; stamineal column about 4 mm. high: capsules pale, subglobose, 2–3 mm. high; seeds irregularly obovoid-subglobose, black, distinctly alveolate, about .75 mm. in diameter.

NORTH CAROLINA to Florida, mostly in flat sandy woods, flowering in April and May.

NORTH CAROLINA: "Read," Herb. Acad. Nat. Sci. Phil.: Selma, April, 1899, W. W. Ashe.

SOUTH CAROLINA: Aiken, May, 1899, W. W. Ashe.

GEORGIA: Brunswick, April 16, 1899, W. W. Ashe.

FLORIDA: South of Jacksonville, fourteen and twenty miles, May 13 and 18, 1899, W. W. Ashe.

An exceedingly delicate plant, being one of the most slender species of the entire genus. In its most slender state, the stems and leaves appear almost thread-form, yet the plant may be equally tall with some of the stoutest species.

Sisyrinchium dichotomum

Dull yellowish-green and glaucescent, not turning dark when dry, 30–40 cm. high, in thin erect tufts, not fibrose-coated at base, the roots slender and simple or nearly so. Leaves rather few, mostly about half the height of the plant, or a few longer, somewhat openly erect, 2–6 mm. wide, often broadened upward to above the middle and tapering-acuminate, rather thin but firm, minutely crystalline-puncticulate, the broader ones somewhat distantly striate-nerved, the edges very minutely close-serr ate to nearly smooth: stems broadly thin-winged and similar to the leaves: inflorescence more or less dichotomous from 2–4 series of nodes, the primary node often below the middle of the plant; leaves of the lower nodes very prominent, elongated and acuminate, manifestly broadened about the middle, sometimes even wider than the basal leaves; branches slightly diverging, usually only one of each pair forked, at least above the first or second node, the lower nodes usually bearing also 2–3 slender, often curved peduncles sometimes over 10 cm. long; uppermost peduncles 3–5 cm. long, often very slender and curved; lower branches 6–12 cm. long, broadly winged, the upper series increasingly shorter and more slender: spathes green, very small, often scarcely broader than the peduncles and keeled on either side of the narrowed base by its ascending wings, straight, the bracts very narrow, thin and weakly few-nerved, sharp edged, more or less unequal; outer bract slenderly attenuate, mostly prolonged beyond the inner one for 2–7 mm., the edges very narrowly white-hyaline below, united-clasping for 2–3 mm. at base; inner bract 8–15 mm. long, slender-pointed; flowers 3–9, white in the only specimens seen, very small, perianth about 5 mm. long, stamineal-column 2–3 mm. high: capsules rather pale and thin-walled, trigonous-subglobose or obovoid, about 3 mm. high on very slender, flexuously-erect, exserted pedicels 15–23 mm. long; seeds only 1–2 in each cell, large, 1.5–2 mm. in diameter, somewhat flattened-subglobose or obovoid, often bluntly angled, strongly umbilicate, black, at first rugulose, but becoming smooth or nearly so and even somewhat shining.

NORTH CAROLINA: Chimney Rock, Rutherford Co., May 11, 1899, fruit mature and only a few flowers remaining. Biltmore Herb.

A rather remarkable species, especially noteworthy by reason of its successively dichotomous system of branching, ample stem-leaves, very small white flowers, small capsules and few large seeds. Apart from its much greater amount of branching its general aspect is perhaps most like that of *S. graminoides* or forms of *S. Carolinianum*, though it may be more nearly related to the following species. It has smaller flowers, broader stem-leaves and fewer larger seeds, than any other eastern species known to me.

Sisyrinchium tenellum

Growing in loose often leafy tufts 15–30 cm. high, not fibrose-coated at base, rather dark dull green, apparently not even glaucescent, usually turning dark in drying; roots soft and slender. Leaves often equaling the stems though sometimes only half as high, very thin and grass-like, soft and openly erect or sometimes firmer and strictly erect, 1–3 mm. or even 4 mm. wide, tapering and cuspidate, acute, distinctly few-nerved with fainter nerves in the very wide interspaces, the edges, as are those of the stem, very smooth or, sometimes, ciliolate-serrulate; stem 1–3.5 mm. wide, loosely erect, weak and very flat mostly with broad thin wings nerved like the leaves; nodes one or two, when two the lower one sometimes below the middle of the stem; bracteal leaves erect, usually long and narrow and surpassing the peduncles but sometimes much shorter; peduncles one or two, seldom three, diverging, subequal or very unequal, 3–12 cm. long, slender, but flat and wing-margined, mostly under 1 mm. wide, sometimes nearly filiform, the edges smooth to ciliolate-denticulate: spathes green, often abruptly deflected, small and narrow, not seldom scarcely broader than the peduncle; bracts membranous, weakly or obscurely few-nerved, slenderly attenuate and very acute, or sometimes the inner one apiculate from a somewhat scarious apex, the outer one usually more or less prolonged; outer bract 12–25 mm. long, mostly surpassing the inner one 2–10 mm., but sometimes subequal with it, slenderly attenuate, the margins narrowly white-hyaline, united-clasping for 2–5 mm. at base: inner bract usually closely appressed, under 1.5 mm. long: interior scales half the length of the spathes or less, becoming brownish tinged: flowers 3–5, violet-blue, distinctly fine-nerved, very small, perianth 5–8 mm. long, stamineal column 2.5–4 mm. high: capsules dark, subglobose, very small, 1.5–3 mm. high, on hairlike exserted pedicels somewhat spreading above; seeds only 2–3 in each cell, globose, rough, only obscurely if at all umbilicate, very small, about .75 mm. in diameter.

Alabama and Georgia, in moist soil, flowering in May and June.

ALABAMA: Lee Co., Auburn, several collections by F. S. Earle, C. F. Baker, and L. M. Underwood, 1896–99, in Herb. F. S. Earle, Ala. Biol. Survey and Columbia University.

GEORGIA: Floyd Co., Silver Creek, May 8, 1899, Biltmore Herb.; Jefferson Co., Louisville, Hopkins, Herb. Miss. Bot. Gard.

An interesting species in close relationship with *S. graminoides*, but smaller, with generally much narrower stems and leaves, much smaller flowers and capsules, and fewer smaller seeds; the leaves and stem are also thinner and softer and usually quite without serrulate edges, the leaves more tapering-acute, the small spathes relatively narrower and often or usually abruptly deflected, the bracts commonly more narrowly attenuate and unequal, the pedicels less exserted and flexuous.

The few-seeded capsules are suggestive of *S. dichotomum* to which, in other respects, the species seems to be related, but not so closely as to need detailed comparison.

The above description of the species has been considerably modified to accommodate the collection cited from Silver Creek, Georgia, represented by a very full sheet of specimens. These differ from all the others in serrulate edges of stem and leaf, more slender peduncles uniformly much surpassing the bracteal leaves, rather broader and straighter spathes of less attenuate subequal bracts, the outer one less united clasping, the inner one mostly abruptly pointed from a scarious tip. It is quite possible that this plant merits separate recognition.

Sisyrinchium membranaceum

Rather low, 20–25 cm. high, and loosely erect or assurgent in thin tufts not fibrose at base, arising from rather loosely short-branched rootstocks, the roots slender and nearly simple: plant scarcely if at all glaucescent, becoming dull brownish-green on the herbarium sheet. Leaves loosely suberect, half the height of the stem or more, 1.5–3.5 mm. wide, cuspidate-acute, very thin and membranous, becoming somewhat shining when dry, delicately but prominently few-nerved with a secondary series of faint nerves in the interspaces which are very minutely and closely crystalline-puncticulate, edges of the leaves mostly minutely close-serrulate: stem similar to the leaves, broadly thin-winged, the raised line of the proper stem very narrow: node one, rarely two, bearing a short erect bracteal leaf 2–6 cm. long, and two slender peduncles 4–10 cm. long, frequently longer than the stem: peduncles flat, wing-margined and serrulate-roughened, distinctly constricted transversely below the spathes, the outer one slightly diverging, often only half the length of the erect inner one: spathes green or tinged with purple, slightly deflected or straight, the subequal bracts thin and membranous and delicately or obscurely veined, rather sharply keeled and almost cuspidate-acute, mostly 15 mm. or less long (13–18 mm.) either one slightly the longer, the outer one narrowly attenuate, very narrowly hyaline-edged, united-clasping below for 4–6 mm., sometimes for half its length: inner bract rather broader above and more abruptly acute: interior scales often equaling the bracts or nearly so, but sometimes much shorter, brownish-tinged: flowers 3–5, violet-blue, perianth rather firm and shining membranous in the dried specimens, the segments obovate-oblong, delicately firm-nerved, slenderly aristulate, 10–12 mm. long:

stamineal-column 5 mm. long, anthers small: capsules dark, trigonous-subglobose, 3–5 mm. high, on delicate slenderly exserted pedicels, erect to widely spreading above; seeds only 2–3 in each cell, immature but evidently large.

FLORIDA: Jackson Co., Marianna, April 20, 1899, in full flower; rich shaded soil. Biltmore Herb.

The relationship of this species is with *S. graminoides* and *S. tenellum*. From the latter it is distinguished at once by much larger flowers and capsules without regard to other characters. The flowers are also rather larger than in *S. graminoides* with the broader segments apparently of a more firmly membranous textuae as also are the more strongly few-nerved leaves; the bracteal leaf is much shorter and less foliaceous, the peduncles relatively longer and the often deflected spathes much smaller, with less herbaceous bracts, the outer one more united, clasping below; the interior scales, though variable, become much longer than they are ever seen in *S. graminoides* and the few and larger seeds are a further noteworthy point of difference. The whole plant is lower and less erect than *S. graminoides* and with a more loosely branched underground system.

Sisyrinchium flexile

Tall and slender, about 50 cm. high, apparently in thin tufts, not fibrose-coated at base, pale green but only slightly if at all glaucous. Leaves long and slender, the longer ones equaling the stems or nearly so, rather stiffly erect, withering-persistent, 1.5 mm. wide, closely few-striate, somewhat obtusely pointed with a hardened tip, at least in age, very smooth throughout: stems equally smooth and slender with the leaves, somewhat flexuously erect, subterete and very narrowly firm-margined; nodes one or two, distinctly swollen, when two the lower one bearing a somewhat geniculate slender branch, nearly terete, with slightly roughened margins and a narrow bracteal leaf, the upper node bearing a very short bracteal leaf, sometimes with hardened incurved apex, and two delicate, nearly terete, slightly geniculate peduncles, 3–7 cm. long; spathes pale, slightly deflected, 15 mm. or more long, narrow, especially the subterete base, the bracts subequal, closely striate, their narrow tips scarious-obtuse or sometimes short-apiculate, the inner one sometimes the longer; interior scales silvery white, ½–¾ the length of the bracts; flowers unknown: capsules 5–10, dark brown and rather thick-walled, broadly oblong or obovoid-oblong, 4–6 mm. high, on erect, more or less exserted pedicels slightly spreading above; seeds numerous, very small, .05–1 mm. in diameter, black, alveolate, umbilicate.

MISSISSIPPI: Petit Bois Island, May 8, 1898, with mature fruit, S. M. Tracy.

A very slender species especially characterized by flexuously elongated stems and leaves, peculiarly thickened nodes, scarious-obtuse bracts and very small seeds. It appears to be nearest to *S. Atlanticum*, but possesses many points of difference. In addition to those above referred to may be noted its less glaucous character, firmer and more wiry and subterete narrowly margined stem, narrower spathes of stiffer, less membranous, and more closely striate-nerved bracts, larger capsules. In the two scant specimens, which alone have afforded the outlines of the species, the shortened and scarious-obtuse, outer bract appears to represent a perfectly normal condition; should it prove to be constant it will afford a unique distinctive character among our species.

Sisyrinchium Tracyi

Pale green and slightly glaucescent, discoloring somewhat in drying, rather stout and stiff, 35–70 cm. high, bearing some loose stiff fibers about the base but not densely fibrose-coated; leaves about 3/4 the height of the plant or longer, firm and erect, 1–3 mm. wide, close-striate, becoming faintly rugulose, tapering-acute, very smooth throughout: stems rigid, straight or outcurved, 1.5–3 mm. wide, subterete and narrowly firm margined, very smooth; inflorescence stiff and, at least in its early stage, appearing somewhat contracted-sub-paniculate, the lower node bearing one to three erect peduncles and one or two stiff, mostly short branches supporting a cluster of 3 or 4 peduncles; branches subterete and merely margined, smooth or obscurely denticulate, erect or ascending, 4–9 cm. long, the peduncles slender but stiff, approximate, those from the upper nodes 3–5 cm. long; lower bracteal leaf elongated and erect, equaling its inflorescence or shorter, sometimes 16 cm. long; upper bracteal leaves short and stiff: spathes green, sometimes slightly deflected from the abruptly constricted top of the peduncle, about 3 mm. wide, the flattened base rather sharply two-edged, the bracts strongly close-striate, subequal, 15–22 mm. long, the outer one herbaceous or abruptly short-acuminate, the margins white-hyaline, united clasping below for about 5 mm., the inner bract mostly apiculate from a thin scarious-obtuse or truncate apex; interior-scales silvery white, broad, ½ to ¾ the length of the bracts: flowers on erect, scarcely exserted pedicels, violet-blue, the perianth 10–12 mm. long, with long-aristulate segments; stamineal column 5–6 mm. high; fruit not seen.

MISSISSIPPI: Biloxi, March 20, 1898, just in flower, S. M. Tracy.

A rather stout and stiffly erect species, perhaps more suggestive of *S. Atlanticum* than any other but showing material differences. Unlike *S. Atlanticum* it is scarcely if at all glaucous, and has a very rigid and subterete merely margined stem and longer stiffer leaves; the bracteal leaves are more foliaceous and the subpaniculate inflorescence stiffer and more contracted, with the bracts of the spathe thicker and more closely striate-nerved.

Named for Prof. S. M. Tracy whose collections of Mississippi *Sisyrinchia* have furnished several new species.

Sisyrinchium nanum

Described from a single specimen, probably untypical. Low and stiff, 12 cm. high, pale green and glaucous, not at all fibrillose at base, the long descending roots nearly simple and slightly thickened: leaves erect, some of them equaling or surpassing the stems, 1–2 mm. wide, prominently close-striate, tapering to a stiffened subterete, acute apex, very smooth, or sometimes, when young, roughened on the sides with minute points and with denticulate edges, firmly membranous below and abruptly expanded-clasping at the extreme base: stems subterete and stiff with firm narrow margins, the edges smooth; node only one, bearing an erect leaf about equaling the single short outcurved peduncle; peduncles about 3 cm. long, very narrowly margined, smooth-edged or obscurely denticulate, constricted below the spathe; spathes 13 mm. long, narrowed below; bracts closely striate-nerved, the outer one narrowed to a short-pointed apex, the margins broadly white-hyaline to the tip, united-clasping for 5 mm. below; inner bract prominently surpassing the outer one, broadly scarious obtuse and abruptly contracted to the short-apiculate apex, interior scales broad, acuminate, the longer equaling or exceeding the outer bract; flowers apparently few, on slightly exerted pedicels, bright violet-blue, about 10 mm. long; stamineal column 4 mm. high.

MISSISSIPPI: Horn Island, June 1, 1898, Prof. S. M. Tracy.

The specimen cited is a very small plant only just in flower, and it is scarcely probable that it is fairly representative of its species. Ordinarily there would be little excuse for proposing a new species on so slender a basis, but I have the less hesitation in so doing in the present case because it is impossible to reconcile the specimen with any species known to me and the exact locality where it was collected being known the true status and relationship of the plant can be readily ascertained at some future time.

It is to be compared especially with *S. tortum*, agreeing with that species in the short stamineal column; but it differs obviously in other characters, notably in the entire absence of the fibrous investiture of the base of the tufts.

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Vol. VII. No. 151—(current).

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 167

ANTHURUS BOREALIS BURT

BY DAVID GRIFFITHS

NEW YORK
1899

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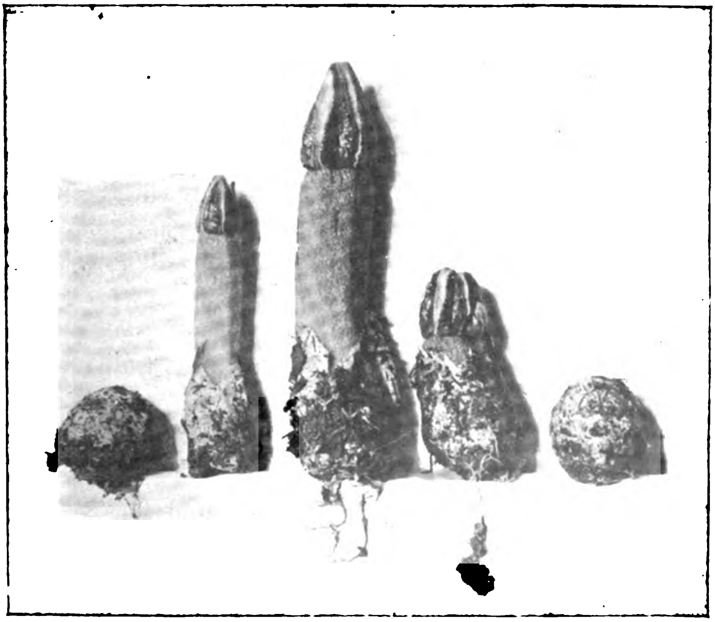
Anthurus borealis Burt.

BY DAVID GRIFFITHS

This rare and interesting fungus so beautifully illustrated and fully described by Prof. E. A. Burt, Mem. Boston Soc. Nat. Hist. **3**: 487–505, has been found in a third locality in the state of New York. It has also been collected in one locality in Massachusetts. This then makes the fourth station in which the fungus has been collected. The last locality has furnished more material than any of the others, besides giving some additional data which are thought worth recording.

The records of the distribution of the plant which have come to my notice are as follows: East Galway, Saratoga Co., N. Y., Sept., 1896, E. A. Burt; Sherruck, Delaware Co., N. Y., Aug., 1897, F. B. Southwick, Annual Rep. State Bot., N. Y., 1897: 132; Waltham, Mass., Autumn of 1898, on authority of G. E. Morris; New York City, N. Y., Oct., 1899.



The first collection made the past season was on the eighth of October, in a rectangular plot of ground at the rear of the Library of Columbia University. The area is planted with ornamental shrubbery, and is completely covered with a thin layer of manure and rubbish used as a mulching for the young shrubbery. The surface of the ground has not been disturbed since early spring. The soil is a yellow clay mixed with considerable sand. There are surrounding the library four of these rectangular areas, one at each of the four angles of the building. The treatment of the soil, the planting and the mulching has been practically the same on the four areas during the season, but the two rear ones alone furnished crops of *Anthurus*. The one at the northeast corner produced but about a half dozen plants, but the one at the northwest corner furnished a great number. The locality where the plants were developed in abundance was, therefore, a shaded one, partially protected on all sides by buildings and trees.

It is certain that some plants matured and decayed before their presence was discovered; but the activity of several collectors in the vicinity would reduce the probability of their appearance to not earlier than the first of October. The last mature plants were collected on the 20th of the same month. On two occasions after this date, however, good sized eggs were secured. The last eggs were obtained on the 26th. These elongated in a moist chamber on the 29th. We can then say that the plant appeared approximately during the entire month of October. Doubtless the sudden decline of the temperature from the 19th to the 22d, the drouth which prevailed from this period onward, and the continual disturbance of the ground in search for the eggs all contributed to prevent further development after the 20th.

An abundance of material in various stages of development has been preserved. No less than two dozen eggs were allowed to develop in a moist chamber. One not over 1 ½ cm. in diameter produced an apparently normal plant of but 6 cm. in length. Several smaller eggs than this were secured, but none of them developed. The smallest egg seen was 3 mm. in diameter. The largest plant secured was one which developed naturally on the campus. It measured a little more than 19 cm. in length. The largest plant in the accompanying cut developed in a moist chamber from one of the largest eggs gathered. It measured 16 cm. in length. Fully 60 plants were seen during the month; making allowance for those which decayed unseen, there probably developed 75–100 plants on this small piece of ground.

Eggs considerably developed possess an enormous amount of vitality as evinced by the readiness with which they developed in a moist chamber after being separated from the mycelium. But this is true to a greater or less degree of many if not all of the phallales. One egg which had lain in a moist chamber for two days was cut in two in a median longitudinal plane one morning at 9 o'clock. The two sections were laid on a white piece of paper with the cut surfaces uppermost and placed in a south window to dry, for the purpose of making herbarium specimens of them. Although they remained in the window all day, and in direct sunlight not less than four hours, they elongated during the following night. The cut surfaces of the stipe were dried so that they could not elongate much, but the convex side of the sections elongated to nearly the normal length, and curved around the cut surface making semicircular figures.

Several methods of preservation were resorted to, but the one adopted by Professor Underwood was, on the whole, the most satisfactory, particularly for exhibition purposes; this consisted in stuffing the stipe with cotton and then fixing in 60% alcohol. A strong solution of formalin, 15–30%, gave fairly good results also, but a considerable amount of contraction occurred with all of the fixatives used.

It is fortunate that the plot of ground on which the fungus grew is so favorably situated. It will in all probability remain in practically the same condition as it is now for some time, thus giving an opportunity of studying the plant in the same locality for two or more successive years. It will be interesting to know whether, under favorable circumstances, the plant will appear again in the same locality next year.

Usually the eggs were found aggregated in groups of two to five. The mycelium was very abundant under the mulching, but the eggs were always more or less imbedded in the ground, and always connected with it by strong mycelial strands. The great variation in size has already been mentioned, but this was not necessarily the result of artificial development in a moist chamber, for several very small plants, about 8 cm. in length, were found developed under natural conditions. These, however, as a rule, grew beyond the mulching in the edge of the grass. The number of branches of the receptacle is quite variable. Professor Burt described the plant with five fully developed branches and one abortive one. While this is apparently the normal condition in our specimens, a large number were found with seven arms and a few with eight. But whether with six, seven or eight, the abortive or smaller branch is nearly always present.

The accompanying cut was made from a photograph by Dr. C. C. Curtis, taken from plants which elongated in a moist chamber. The plant in the center of the figure and the one next to it on the right are fully extended. The outside objects are medium sized eggs. The figures are reduced to a little less than one half natural size.

COLUMBIA UNIVERSITY, Nov. 15, 1899.

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 166

TURGIDITY IN MYCELIA

BY CARLTON C. CURTIS

NEW YORK
1900

[Reprinted from the BULLETIN OF THE TORREY BOTANICAL CLUB, 27: 1-13. 24 Jan., 1900.]

Turgidity in Mycelia

By Carlton C. Curtis

Although the question of the mechanics of growth has been canvassed since the time of Nägeli by so many writers as Schmitz, Krabbe, Wortmann, Strasburger, Eschenhagen, Askenacy, Zacharias, Noll, Schwandener, Strange, Reinhardt, Hegler, Pfeffer, True, and Copeland, we must still agree with Krabbe, that an acceptable theory of growth does not exist. Especially are we indebted to the researches of Pfeffer as set forth in the "Druck und Arbeitsleistung durch wachsende Pflanzen" and the second part of "Studien zur Energetik der Pflanzen" for an elucidation of the various phenomena associated with growth. Especial attention is called by Pfeffer to the fact that the mechanics of growth may not only vary in different cases, but that all growth is dependent upon the coöperation of many factors. Consequently the retarding or quickening of the rate of growth may not be ascribed to any one agency. So in regard to turgidity its action may be more than counter-balanced by other forces, and we find no "fixed relation between the turgor force, stretching of membrane, and rate of growth." The present work was undertaken to determine just what relation turgidity sustains to growth when all other conditions, so far as possible, are kept constant and only known variants are introduced. The hyphae of fungi were used for these observations. They were grown in nutrient solutions of varying degrees of concentration and transferred to solutions of higher or lower concentration. In this way wide variation of turgidity was created, and as the moment of the renewal of growth in the hyphae

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could easily be detected, it was possible to test the turgor force at the instant of the recovery from the effect of the change of substratum. The basis of all media used in the experiments which are here recorded was a nourishing solution composed of 3% cane sugar, .5% peptone and .5% beef extract, and from this were made solutions containing various gram-molecule percentages of potassium nitrate. By this means the plants were always afforded a constant nourishment and the effects of the introduction of a known factor, potassium nitrate, could readily be determined. In many respects the hyphae of the lower fungi are especially adapted to this character of work since they are easily cultivated and handled in microscopic examinations, and possess, to a marvelous degree, adaptability to varying degrees of concentration without injurious results, and are so simple in structure that changes of culture media produce immediate reactions. Many will grow in a saturated potassium nitrate solution, about 23%, and some will endure a transfer from relatively strong to zero solutions without bursting. The suitableness of these plants for measuring the turgor force is more apparent when we consider that Pfeffer has determined that in an artificial cell a 1% potassium nitrate solution produced a pressure 175.8 cm. of mercury, and that this estimate is low since the precipitation membrane is somewhat permeable for potassium nitrate.

It was found impossible to study the behavior of the mycelia in gelatine or agar since these media not only dissolve at relatively low concentrations of the substratum, but they are also objectionable as being somewhat unstable and permitting a rather slow and gradual penetration of the various culture solutions. Gypsum proved a fairly satisfactory means of fixing the spores for germination and subsequent study. The powdered gypsum was mixed into a paste with water, and to this mass the spores were added. The mass was then readily pressed out into a thin plate between glass slides, and hardens in a few minutes. These thin plates, however, were somewhat difficult to fasten to the slides, and are liable to break during an experiment. So attempts were made to germinate the spores in floss silk and strands of cotton fibers fastened to the cover glass with drops of balsam, and this led to a very simple and practical culture method. The spores were fastened to the cover glass with a film of dilute gelatine and covered with a narrow strip of silk paper or any thin unsized paper about 5 mm. long and 1 mm. wide. Each end of this paper had been previously touched with melted shellac so that a drop adhered to it. By applying a hot rod over the drop of shellac it is melted, fastening the paper firmly to the cover glass. In this way the paper is spread out smoothly over the spores, holding them firmly on the glass. The spores will germinate and push out from under the strip of paper and the mount can be handled without fear of destroying the hyphae, readily changed from one fluid to another and the growth studied in a hanging drop with ease. Furthermore the same hyphae can be observed during the entire experiment, and any error that might arise from a change from one filament to another can be avoided. Every precaution was taken to secure uniform external conditions. Repeated tests during the day showed that the ordinary variations of temperature produced no effect on the turgor force and rarely was there a variation of over one and a-half degrees during the majority of the experiments. The work prosecuted in the summer, however, was subject to a much more considerable range of variation than in the winter.

In regard to illumination, the alternation of light and darkness and different degrees of light intensity gave no different results from those obtained when the plants were grown in the dark room and received illumination only from the mirror of the microscope for a few moments at the time of the observations. For the purpose of uniformity all the cultures and examinations were made under the same conditions so far as possible and the greater part of the experiments were conducted under exceptionally uniform conditions.

The spores used were always taken from recent cultures since they produced plants of more uniform vigor. But even with this precaution here was presented the most serious difficulty in the work. For, having sown a few spores on a cover glass, not only do some fail to germinate but some are very slow to grow and others show a great vigor. Again, some will produce almost from the start a branched series of filaments and others will develop lateral branchlets only after extended growth. Now it is evident that these variations are the expression of different conditions and forces existing in the plant and if the measurement of the turgidity is to be of any value it must be determined from plants presenting a uniform vigor of growth. It was often a difficult task to find in successive cultures hyphae showing the same vigor and condition of growth. The fluctuations in the rate of growth due in some cases to preparations for branching on the part of the plant and in other instances due to no apparent cause, rendered it difficult to select plants in the various experiments that would give real comparative values. This difficulty presented itself again when changes from one media to another had been made. For perhaps the hyphae under observation would not respond to the change for half an hour or longer after others had showed the desired effects. The question then presents itself, How much weight can be given to any measurement in such an instance? Obviously such conditions necessitated repetition of experiments many times to arrive at any conclusions.

To secure the most uniform conditions possible the spores, prepared as above described, were germinated in closed Stender dishes, 8 × 4½ cm., the cover glasses being just covered with the fluid. By this means the spores and germinating plants were exposed to the same atmospheric conditions and always had the same volume of nutrient solution to draw upon, while the solution could not materially absorb or evaporate water—factors of vital importance to the success of the work. By removing the covers of the dishes the cultures could readily be examined on the table of the microscope without danger of disturbing them and when found ready for use the cover glass was removed, carefully freed of the fluid with a blotter save about the hyphae and studied in a hanging drop over a damp chamber. In all experiments the damp chamber (made from a piece of thick cardboard) was placed in a Stender dish, the bottom of which was covered with the same solution as used in the hanging drop. I found this to be of the greatest importance for if there was any considerable variation in the concentration of the hanging drop and the fluid of the damp chamber a very considerable change would result in the concentration of the hanging drop producing very material alterations in the rate of growth and turgor. In this way the damp chamber was also constantly kept saturated and the drying up of the drop prevented. Having selected from the drop culture a plant for testing, the cover glass was quickly freed from all fluid possible by means of the feathered edge of blotting paper, washed in the solution to which it is to be transferred, placed in a Stender dish and covered with the fluid after the manner described for germinating the spores. This insured an immediate action of the substratum and, owing to the relatively large volume of the substratum, it is not subject to any material change through the metabolism of the plant or the diffusion of any portion of the previously used culture fluid which might still cling to the cover glass through the capillarity of the paper or mycelia. Of course when the period of recovery from a change was short it was only necessary to wash the culture in the fluid to which it was to be transferred and mount it on the damp chamber in a fresh drop of this fluid. Knowing, by experiment, approximately when the plants would recover from the change of substratum, the cover glass was wiped dry, leaving a hanging drop on the mycelia, and placed on the damp chamber.

It was possible to determine the exact moment of renewal of growth after a change of substratum owing to the fact that this was announced by the enlargement of the apices of the hyphae, which were very constant and characteristic features. The turgidity of the plant was tested at this moment, although the swelling would go on for varying lengths of time, amounting in some cases to 10 or 15 minutes before a branch or usually branches would appear that increased the length of the hyphae.

Every precaution possible was exercised to secure accurate measurements of the turgidity. With the first sign of the enlargement of the apex the cover glass was freed of the fluid and immersed in the plasmolyzing fluid, isotonic solutions of sodium nitrate being used. A stock of the various percentages required was made up and used through all the experiments, and fresh volumes were taken from these jars for each experiment. The turgor force of a plant recovering from a change was always compared at the same time with the turgor force of a plant that had germinated and grown in the same strength of fluid to which the trial plant had been changed. In this way two plants in the same condition of development were compared, the one with the turgor normal to the solution in which it was growing and the other had so adjusted its turgor to this same concentration of the substratum that growth became possible. It was found, after trying a certain percentage of the plasmolyzing solution on a plant without producing plasmolysis that any subsequent tests with higher strengths were unreliable, giving too high values to the turgor force. This is doubtless due to the fact that a solution too weak to plasmolyze does cause a concentration of the cell contents as is seen from the reduced size of the hyphae. One of the surprising features of the work was the variability of the turgidity, so that it was not at all safe to rely upon any determination of the turgor force of plants grown in a given concentration as a basis for comparison of plants changed to this concentration; as mentioned above, a test plant was always used as a check upon all measurements. This variability of the turgidity was also observed while working with Prof. Pfeffer, for whose courtesy in extending to me the privileges of the laboratory, I wish to return thanks.

Some of the results of the experiments upon *Mucor* will be found in the first table. The first column shows the average temperature of the day on which the experiment was made. In the second column is the record of the changes of the substratum; thus 0–4 indicates that the spores were grown in a simple nutrient solution and transferred to a nutrient solution containing 4% KNO_3. The third column shows the time elapsing after the change before growth appeared. For example, in the first experiment the culture was transferred at 8.10 to a 4% KNO_3 nutrient solution. Growth ceased till 10.13, or growth was renewed after two hours and three minutes. The turgidity in percentages of $NaNO_3$ is found in the fourth column. A — after a number indicates that this percentage did not plasmolyze as perfectly as in the case of the plant used as a check and for comparison. A + signifies the reverse condition, and that the plasmolysis was more severe than in the check plant. N. P. indicates that the percentage used failed to plasmolyze at all the hypha. The last column includes the measurements of the turgidity of the plants used as checks and for comparison with the plant subject to the change of substratum. Considering the second experiment, 18 in the fifth column indicates that this was the turgor force of plants germinated and grown in a 4% KNO_3 nourishing solution on the day of the experiment, while in the fourth column 18 — records the fact that this same strength of the plasmolyzing solution did not plasmolyze as strongly the plant that was subjected to the change of concentration.

I.

1	2	3	4	5
21.	0–4	2.3	17 n. p.	18
21 5	"	2.15	18 —	18
22.	"	1.43	18	18
21.5	"	1.35	18 —	18
22.	"	1.45	18 +	18
22.6	"	.59	20 +	20
22.6	"	1.33	20 +	20
22.6	"	1.25	20 +	20
21.5	"	1.50	18 —	18
20.8	"	.45	18	18

These are a few illustrations taken from many experiments to give an idea of the range of variation in different cases. The interesting feature appears in columns 4 and 5. All the measurements show practically the same result, that before growth is renewed the turgor force has become equal to the turgor of plants growing normally in this solution. Scores of experiments were performed testing the plants as in the first experiment with a lower percentage than the check plant indicated. The result was either as in this case a lack of plasmolysis or only slight indications of it.

II.

1	2	3	4	5
22.	4–0	15 min.	8	8
22.6	"	40	8	8
22.6	"	34	8	8
21.5	"	20	8 —	8
21.5	"	50	8 —	8
25.	"	35	7 n. p.	8
25.	"	30	8	8
23.	"	47	8 —	8
22 5	"	28	8 +	8
21.	"	32	8 —	8

The three measurements indicating a turgor force of 20 are introduced to illustrate the variations that appear without any assignable reason. From other experiments it is not at all possible to conclude that temperature is the cause of the rise.

In Table II. will be found some of the results obtained by germinating spores of *Mucor* in a nourishing solution containing 4% KNO_3 and transfering to a simple nourishing solution.

Here again there is a complete agreement between the turgor forces of the plants grown under the different conditions; the slight variations indicated by the — or the + are of little importance as they are found to be equally distributed throughout my experiments. The turgor force was not always as constant as indicated in column 5, some tests showing a force of 7 and a few of 9. In the majority of cases it was very constant.

In Table III. are given a few of the results of experiments on *Botrytis*.

III.

1	2	3	4	5
21.	0-4	.41 min.	22	22
22.2	"	.60	22—	22
22.6	"	1.12	22 n. p.	22
21.	"	1.10	22	22
21.8	"	.50	23	23
23.4	"	1.35	22 n. p.	23
24.	"	1.53	21	21

IV.

1	2	3	4	5
22.	4–0	50 min.	12 n. p.	13
22.8	"	51	12	12
21.6	"	55	12 +	12
23.4	"	42	12	12
22.6	"	62	12 —	12
22.6	"	38	12	12
24.	"	46	12	12

The generally longer period of recovery noted in Table IV. is not due apparently to the considerably higher turgor force developed in the plants, since the difference of turgor in the 4% and null solutions is practically the same in both *Botrytis* and *Mucor*, *i. e.*, 10. On the other hand the periods of recovery found in Table III. are somewhat shorter than in Table I.

The tests upon *Penicillium* were more unsatisfactory than any ot the others owing to the fact that the turgor varied considerably on different occasions. It might naturally be supposed that this was due to some faulty application of the plasmolyzing solutions. More tests, however, were made upon *Penicillium* than upon any of the others in the hope of securing uniform measurements. But the fact remained that there would occur variations of one to three per cent. But this fluctuation does not affect the results of the work because of the practice of comparing every measurement obtained in an experiment with the turgor force of a test plant.

V.

1	2	3	4	5
21.	0–4	63 min.	16 —	16
21.4	"	41	16	16
21.8	"	76	15	15
21.8	"	70	13	13
21.6	"	46	16	16
22.	"	47	16 —	16
21.4	"	88	16 +	16

VI.

1	2	3	4	5
22.6	4–0	21	10 —	10
22.8	"	25	10	10
22.8	"	45	10	10
22.	"	38	8 +	8
21.4	"	22	9 +	9
21.6	"	50	9	9
21.	"	42	9	9

It is very noticeable that the turgor force has a marked influence in regulating the period of recovery. While in Table III. it is more usually over one hour and averages somewhat higher than the table indicates, in Table V. the recovery is decidedly shorter. The same ratio exists in Tables IV. and VI. In the case of *Botrytis* there was produced by the changes of the substratum a difference of 10 in the turgor force while in *Penicillium* this only amounted to about 6. The results obtained in the experiments with *Mucor* are not so easily explained, for while the period of recovery is shorter than in *Penicillium*, when changing from 4 to 0, the reverse change results in a rather longer period of retardation approximating that of *Botrytis*. This latter relation would be be expected since the difference in turgor produced by the two substrata are about equal, *i. e.*, 10. It is quite possible that the structure of the two plants has much to do with the variation, the one being essentially weak in this particular and the other septate.

I was interested to substitute NaCl for KNO_3 for the purpose of determining whether the replacement of a salt that is of so vital importance to the plant with one of slight value would produce any pronounced results. The action of this salt was most striking and it was found impossible to use only comparatively weak solutions. *Mucor* would not tolerate as well a 2 per cent. solution as the corresponding value of KNO_3, and this often produced bursting in *Botrytis*. *Penicillium* was more resistant and would usually withstand a change from 4 to 0. The results may be summarized as follows:

Mucor in a temperature averaging 24.5 recovered very slowly in changing from a nutrient solution to 2% NaCl solution. The period ranged from 3 hours and 40 minutes to 5 hours and 46 minutes and the turgor was found to be 21–22 in the recovering and test plant. In transferring from 2 to 0 recovery was effected in 19 to 43 minutes, turgor force 9. This higher turgor force (9) was probably due to the temperature and this is to be noticed generally in all work done in the summer. *Penicillium* recovered, temperature 25, from a change of 0 to 2 in 1.24 to 2.36 hours, turgor in all comparative tests alike and ranging from 19 to 20. Transferring from 2 to 0, recovering in 36 to 56 minutes, turgor ranging from 11 to 12. Changed from 0 to 4 solution, recovery 1.55 to 2.50 hours, turgor 29–30; transferred from a 4 to 0, recovery in 31 to 70 minutes with turgor force as stated above. *Botrytis*, transferred from 0 to 2% solution, recovered in 1.40 to 3.10 hours, turgor 23–24. Changing from 2 to 0, recovering in 30 to 80 minutes, turgor 13. These tests show the same results and general relations as those found in Tables I and II. The excessive turgor pressure is manifestly due to the injurious and retarding influence of the NaCl upon the rate of growth.

A summary of the results obtained with the higher concentrations of the KNO_3 nourishing solutions is given below. *Penicillium* was found to have the greatest power of adaptation and would sometimes withstand a transfer from 19 to 0 solution without seriously bursting all of the hyphae. In transferring *Penicillium* from 0 to 9 recovery followed in 2 to 5.30 hours, turgor 28. Changing from 9 to 0, recovery in 50 minutes to 1.50 hours, turgor 11; changed from 0 to 14, recovery 2.40 to 7 hours, turgor 36; changed from 14 to 0 recovery, 55 to 1.41, turgor 11; changed from 0 to 19, recovery 5.40 to 12.18 hours, turgor 43. *Botrytis* 0 to 9, recovery in 1.56 to 6.10 hours, turgor 34, 9 to 0, recovery 48 to 2.21, turgor 13, 0 to 14, recovery in 3.10 to 7.43, turgor 39. Less importance is attached to these experiments owing to the frequent bursting of the hyphae. However, they show that the same relations exist between the turgor of the recovering plant and the test plant as appeared in the preceding work.

The result of the work was unexpected and seems to indicate that a much closer relation exists between turgor and growth in these simple plants at least than has been supposed. I had anticipated finding several percentages of difference between the turgor force of the plant just recovering from a change of substratum and that of a plant germinated and grown in this substratum. It appears from these experiments that there is a necessity of a certain turgor force before growth is possible and that growth cannot occur until a turgor pressure has been reached which is normal to the plant growing in the given solution. That turgor is not alone the cause of growth is apparent from the acceleration of the rate of growth after a change of substratum. In the following statements it will be seen that there is always a short period of slow growth. The figures represent divisions on the micrometer eye piece, the periods of measurement being 5 minutes.

1 5	1.5	1.	2.	.5	.5
1.	1.5	2.	2.5	1.	.5
2.5	2.5	3.5	3.	.5	2.
3.	3.	4.5	3.	1.5	2.5
3.	3.5	6.	3.	3.	3.

Again it is to be noticed that when the turgor pressure was enormously increased by changing from high to low concentrations no growth followed but the quite uniform period of recovery indicates that some agency other than the widely various turgor pressure was at work and it seems quite probable, as has been suggested by Townsend and by True, that the cessation of growth is to be considered as the response of the irritability of the protoplasm due to shock. In fact, the measurements obtained by Townsend by injuring the hyphae and observing the period of recovery correspond with some of the above measurements. This shock also entered as a factor in the changes from low to higher concentrations, but the periods of recovery constantly grew longer in as much as the accumulation of turgor force is a slow process and requires more time than recovery from shock. In the cases where we are dealing with a reduction of the turgor force a comparative short period, *i. e.*, the recovery from shock, is sufficient to adjust the turgor since this is brought about by purely physical laws. The accumulation of high pressures in the plants retarded in their growth by NaCl and the low turgor of the plants growing rapidly in solutions of slightly lower concentration, a phenomenon that has often been discussed, seem to point to the same conclusion. A certain maximum turgor force is necessary to start growth. If for any reason growth is checked there follows an increase of the pressure tending to continue the normal growth. Under the reverse conditions a rapid growth lowers the pressure which is, however, high enough to play its rôle in growth. Eschenhagen has demonstrated that the turgor pressure of fungi is considerably in excess of the substratum in which they are growing and this is to be looked upon as an adaptive provision permitting changes of substratum. It is possible that there must also be a certain excess of turgor to inaugurate growth and higher than is actually required to sustain it. Naturally a rapid growth expends a portion of this surplus reducing turgor. These variations of pressure are comparable to the work done in overcoming the inertia of an object at rest, a greater force is required to start the motion that is necessary to maintain it. A better comparison is found in a water reservoir with a constant supply and a siphon discharge. A certain maximum volume of water is required to bring the siphon into action, but once in action it will continue the flow of water, though the volume in the reservoir is greatly reduced. Furthermore, by reducing the caliber of the siphon the volume rises, but by increasing it the volume diminishes in both cases in proportion to the area of the siphon.

Turgor then is regulatory in its action. We can neither say that it controls growth nor, on the other hand, is it controlled by growth, but it must sustain a certain fixed relation and come into harmony with the other existing forces and conditions before growth is possible.

The more important features of the work may be summarized as follows:

1. The hyphae of fungi possess remarkable powers of adaptation but show considerable individuality in this respect.

2. The turgidity varies under uniform conditions.

3. The moment of recovery from a change of concentration can be accurately noted since it is indicated by an apical enlargement preceding the elongation of the hypha.

4. Changes from a low to a higher conception of the substratum resulted in a steadily increasing period of recovery in proportion to the concentration of the substratum.

5. Recovery from a change from a higher to a lower concentration was controlled only to a limited extent by the degree of concentration. But there was also to be observed an individuality peculiar to the genus employed which brought about these changes in shorter or longer periods of time.

6. The turgidity of a plant recovering from a change of concentration is the same as that of a plant germinated and growing in the concentration to which the trial plant has been changed.

7. Turgidity appears to be a regulatory force.

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A REVIEW OF THE SPECIES OF LYCOPODIUM OF NORTH AMERICA

BY FRANCIS E. LLOYD

AND

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A Review of the Species of Lycopodium of North America

BY FRANCIS E. LLOYD AND LUCIEN M. UNDERWOOD

(WITH PLATES 2, 3, AND 4.)

The genus *Lycopodium* as represented in North America has never received a careful revision. Various forms, mostly varietal, have been described from time to time but the treatment in the various manuals has been mainly that accepted by European writers, commencing with Linnaeus and closing with Milde. Meanwhile a large amount of material has accumulated and we are in the position to give the genus a preliminary survey and bring our knowledge of the American species up to the datum line of modern collections. Much still remains to be done to clear up certain outlying forms and limit the range and variations of certain species and, if possible, determine the causes involved.

The genus *Lycopodium* as treated by Baker * includes ninety-four species and this may be regarded as a very conservative estimate of its extent. Certain features of the range of species are of interest. Five species are circumboreal and are distributed more or less widely throughout the North Temperate Zone. Europe has seven species, viz, *L. Selago*, *inundatum*, *annotinum*, *clavatum*, *alpinum*, *complanatum*, and *chamaecyparissus*, all but the second and last being circumboreal and all being found in North America.

In extratropical North America, Baker recognized ten species. To these six must be added, of which three are here recognized as species for the first time. *L. cernuum*, a widely distributed tropical species, also enters our Gulf States. To these Mexico adds seven species, of which *L. serratum*, originally described from Japan, is very doubtfully Mexican, and the rest are species of the West Indies. These islands add six more, of which *L.. rigidum* is endemic and the others are species of wider range through tropical America. South America has some forty-one species, of which twenty nine are endemic and of these twenty-one are confined to the Andean region; two are also African, two North American and the rest are neotropical.

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* Handbook of Fern Allies, 1887.

Asia follows with twenty-six species, of which two are endemic in Japan and four in India; of the others, ten (including the five circumboreal species) are also found in the United States, nine in the East Indian Islands, and four in Polynesia. Africa has only thirteen species, of which eight are endemic; of these five are from the mountains of Madagascar. The East Indies have eighteen species, of which four are endemic; ten are species of the adjacent Asiatic mainland, and four are shared with Polynesia. Australasia has thirteen species, of which eight are endemic. Polynesia has nine species, of which only one, *L. polytrichoides*, is endemic in the Hawaiian Islands. Finally, the little island of Tristan d'Acunha has two species, both endemic.

The American species north of Mexico may be separated by the following key:

Plants with mostly upright stems with alternating zones of leaves and sporophylls (strobiles interrupted).

Leaves hollow at their bases and appressed. 1. *L. Selago.*

Leaves flattened at their bases and ultimately more or less reflexed.

Leaves linear or nearly so, entire or very minutely denticulate. 2. *L. porophilum.*

Leaves distinctly broadest above the middle and erose. 3. *L. lucidulum.*

Plants with more or less extended horizontal stems; the sporophylls aggregated into terminal strobiles.

Sporangia subglobose; sporophylls similar to the foliar leaves.

Sporophylls short (5–6 mm.).

Sporophylls deltoid, mostly entire; plants small. 4. *L. inundatum.*

Sporophylls contracted above the base with a few teeth; plants large. 5. *L. adpressum.*

Sporophylls longer (8–10 mm.), usually much toothed.

Leaves in many rows, radially arranged; stems arching. 6. *L. alopecuroides.*

Leaves arranged so as to lie in nearly one plane; stems pinnately branching, prostrate. 7. *L. pinnatum.*

Sporangia transversely compressed, reniform; sporophylls entirely unlike the foliar leaves.

Leafy stems short (2–15 cm.), prostrate, leaves lying nearly in one plane, none beneath. 8. *L. Carolinianum.*

Stems with abundant erect or ascending leafy branches.

Leaves equal, radially arranged (except on the terminal branches of no. 11) in five or more rows.

Aerial portions dendroid.

Strobiles few, stout, erect. 11. *L. obscurum.*

Strobiles numerous, short, nodding. 12. *L. cernuum.*

Aerial portions extensively trailing, with clustered branches.

Leaves in five rows; stems and branches slender (2 mm.). 13. *L. Sitchense.*

Leaves in more than five rows.

Strobiles solitary, sessile. 9. *L. annotium.*

Strobiles 1–several on evident elongate peduncles. 10. *L. clavatum.*

Leaves in four rows on flattened aerial dorsiventral stems.

Branches convex on both sides; leaves alike in all four rows. 14. *L. sabinaefolium.*

Branches with under surface flat or concave.

Strobiles pedunculate, peduncles usually forked twice.

Leaves of under row scarcely reduced; terminal. 15. *L. chamaecyparissus.*

Leaves of under row much reduced to a subulate tip; terminal branches spreading, horizontally fan-shaped. 16. *L. complanatum.*

Strobiles sessile upon stronger leafy branches; leaves of the under row trowel-shaped. 17. *L. alpinum.*

1. L. SELAGO L. Sp. Pl. 1102. 1753

Prostrate portion of stem very short, abundantly rooting, soon curving upward and dichotomously branching to form compact tufts (4–17 cm. high) of vertically placed branches with dense foliage: leaves more or less appressed, or at least upwardly directed, triangular (1.5 × 4 mm.) to linear-acuminate (0.5 mm. × 5 mm.) or aciculate (1 mm. × 8 mm.), broadest at the hollow base, gradually tapering to the acuminate apex, entire: sporophylls shorter than the leaves, triangular: sporangia reniform: plant very frequently gemmiparous.

A boreal and arctic plant, showing a considerable degree of variability. Alaskan material shows a range of variation in its leaves which measure from 2 × 4 mm. to 1 × 8 mm., and this in the same habitat, judging from a series of specimens collected by Thos.

Howell, at Yes Bay, Aug. 21, 1895 (N), and another in the same locality Aug. 26, 1895, by M. W. Gorman. Slender-leaved material comes also from Kadiak Is. (B. J. Bretherton, July 23, 1894).

Specimens from the Cascade Mts., Washington, Macdonald Lake, Montana, and Twin Lakes show but little differences, the leaves ranging from 1.5 × 4–8 mm. to 0.8 mm. × 5 mm. Specimens from the Northeast, show considerable variation. The forms with the most slender leaves come from the mountains of Vermont, growing in a moist, shaded habitat (A. J. Grout, Mt. Mansfield). These facts, together with the variability found in the moist climate off the Alaskan coast, would indicate that the slender form of the leaf is induced by a wet, shaded habitat.

Other specimens collected by Dr. Grout, at Mt. Mansfield, whether in the shade or not is not stated, have somewhat broader leaves. Plants of Mr. G. G. Hinsdale's collection of the "summit of Mt. Mansfield" (1893) are typical in form, with shorter and broader leaves.

Distribution: Greenland, Labrador, Newfoundland, Maine, New Hampshire, Vermont, New York, North Carolina, Idaho, Washington, Alaska, St. George Island (Behring Sea). A plant with strongly reflexed leaves but otherwise not differing from *L. Selago* is represented by specimens as follows:

IDAHO: Little North Fork Basin "mountain woods," Sept., 1895, J. B. Leiberg (N).

ALASKA: Sitka, F. Bischoff (N).

CANADA: Mud Lake, July, 1891, F. F. Wood (N).

2. **L. porophilum** sp. nov.

Prostrate portion of stems short, abundantly rooting, curving upwards, then dichotomously branching 1–3 times to form a rather dense tuft (4–10 cm. high) of vertical stems, densely clothed with spreading or reflexed leaves: leaves (7–9 mm. × 1 mm.) very slightly broadened above the middle and similarly contracted toward the base, those between the strobilar regions shorter (6–7 mm.), broadest at the base but very gradually tapering, entire or very minutely denticulate: sporangia compressed reniform: sporophylls minutely denticulate above the middle or entire, acuminate (4–5 mm. × 1 mm. wide at base): plant often gemmiparous.

A plant intermediate in habit between *L. lucidulum* and *L. Selago*, having the leaves spreading or somewhat reflexed, with the alternation of long leaves and short sporophylls. Leaves not hollow at the base but flat as in *L. lucidulum.*

Of very limited range so far as known at present, and confined apparently to sandstone rocks. The plant varies no more than *L. lucidulum*, both differing in this respect from *L. Selago.*

INDIANA: Fern, Putnam Co., Oct., 1891,* L. M. Underwood (U): type.

WISCONSIN: Dells of the Wisconsin, Aug. 19, 1893, L. M. Underwood (U).

KENTUCKY: Mountains, Warren Co., "on the face of sandstone cliffs, June, 1898," S. F. Price (U). Green River, Warren Co., "on a sandstone cliff," June, 1896, S. F. Price (U).

ALABAMA: Winston Co. "under projecting sandstone rocks near Sipsey River," 1 June, 1896, L. M. Underwood (U). This plant differs slightly from the other and more northerly ones in having narrower sporangia.

3. L. LUCIDULUM Michx. Fl. Bor. Am. **2**: 284. 1803

Prostate portion of stems longer (5–15 cm.), frequently rooting, curving upward and dichotomously branching 1–3 times to form a loose cluster (10–20 cm. high) of a few densely leafy vertical stems, or the stems occasionally occur single: leaves reflexed (8–11 mm. × 1.5–2 mm.), linear-obovate, broadest above the middle, from which point they gradually taper to the 1 mm. wide base; margin erose denticulate above the middle, acute: sporophylls 3.5–8.5 mm. × 1.2–1.5 mm., linear, acute, entire or sometimes slightly denticulate: sporangia depressed reniform: plant often gemmiparous.

The rhythmic production of sporangia and the resulting alternation of long leaves and short sporophylls gives the foliage a wavy outline quite characteristic of this plant, with its shining dark green leaves.

Habitat in forests, more commonly in low ground.

Distribution: Newfoundland, Prince Edward Island, New Brunswick, Maine, New Hampshire, Vermont, Ontario, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania Maryland, Virginia, West Virginia, Tennessee, North Carolina, South Carolina, Indiana, Illinois, Missouri, Minnesota, Michigan, Wisconsin.

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* At the Indiana station this species grows with *L. lucidulum*, the latter always in the low swampy ground bordering the small streams, while this species grows along the narrow ledges of the overhanging sandstone rocks. The range of *L. lucidulum* also includes the other stations.

4. L. INUNDATUM L. Sp. Pl. 1102. 1753

Stems creeping horizontally or arching, about 10 cm. long, simple or once or twice forking, slender, 1.5 mm. in diameter, roots produced toward the end of the annual growth: leaves 5 mm. × 0.8 mm. linear-lanceolate, entire, acute, curved upward; those of the peduncles straight, entire, more slender and tapering: peduncles 0.5–6 cm. long or the strobiles sessile: strobiles 0.8–4 cm. long: sporophylls about 5–6 mm. long, 1.5 mm. wide at the base, triangular, usually entire or sometimes toothed just above the base, then somewhat contracted: sporangia subglobose. European material shows denticulation of the sporophylls.

Specimens have been examined as follows:

NEWFOUNDLAND: Bally Haily Bog, St. John, Aug., 1894, B. L. Robinson and H. von Schrenk, no. 135 (N, G).*

NOVA SCOTIA: July, 1884, H. T. Meenan (G).

PRINCE EDWARD ISLAND: 1888, J. Macoun (G).

CAPE BRETON ISLAND: July, 1883, J. Macoun (G).

NEW BRUNSWICK: 1868, J. Fowler (G); Bass River, "rare," Oct., 1875, J. Fowler (N).

MAINE: Bog, Great Cranberry Isle, Sept. 1891, E. L. Rand (U); Mount Desert Island, Sept., 1890, E. L. Rand (U); Dead River, M. L. Fernald, 497 (G); Oxford Co., J. A. Allen (G, N).

ONTARIO: Hastings Co., July, 1876, J. Macoun (C).

NEW HAMPSHIRE: Mt. Willey, Aug., 1878 (Y); White Mts., E. Tuckerman (C, G); Seabrook, Sept., 1895, A. A. Eaton (N).

VERMONT: Hartland, Sept., 1893, W. W. Eggleston (C).

CONNECTICUT: Southington, Sept., 1898, C. H. Bissell (Y).

MASSACHUSETTS: Berkshire Co., July, 1890, A. K. Harrison (U); South Hadley, Oct., 1888, Alice Carter (U); Sudbury, Nov., 1890, L. M. Underwood (U).

NEW JERSEY: C. F. Austin (U).

PENNSYLVANIA: Luzerne Co., Sept., 1890. Small and Heller

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* The letters N, G, C, Y, and U, refer to the National, Gray, Columbia, New York Botanical Garden, and Underwood herbaria in which the specimen cited may be found.

(N); Pocono Mt., T. Green (G); Tobyhanna, July, 1889, N. L. Britton (C).

NEW YORK: Herkimer Co., J. A. Paine (G).

ILLINOIS: Evanston, 1884, H. L. Boltwood (G).

MICHIGAN: Keeweenah Co., 1888, O. A. Farwell (G).

BRITISH COLUMBIA: Vancouver, Aug., 1893, J. Macoun (N).

ALASKA: Short Bay, July, 1895, M. W. Gorman, "wet bogs in upland meadows" (C, N); Aug., 1895, T. Howell, no. 1731 (Y).

4a. L. INUNDATUM BIGELOVII Tuck. Am. Jour. Sci. **45**: 47. 1843*

A larger plant with longer and more abundantly branching slender stems with slightly longer leaves which are entire or toothed. Sporophylls as in *L. inundatum.*

CAPE BRETON ISLAND: Peat bog, North Sidney, 1883, J. Macoun (C).

VERMONT: Stirling Mt., Aug., 1882, O. H. Butler (C); Stratton, July, 1894, A. J. Grout (U).

NOVA SCOTIA: Grand Lake, 1879, E. G. Knight (C).

MASSACHUSETTS: Ipswich, Oakes (C); New Bedford, T. A. Green (C); Plymouth, Oakes and Tuckerman (C); Tuckerman (G); Essex; Sept., 1896, A. A. Eaton (U); Oakes, "in Sphagnosis humidis Novae Angliae" (N).

RHODE ISLAND: Providence, "low, grassy land, July, 1892," J. F. Collins.

NEW JERSEY: Egg Harbor, E. G. Knight (C); Quaker Bridge, June 17, 1890, F. E. Lloyd (Y).

5. **L. adpressum** (Chapman)

L. inundatum, var. *elongatum* Chapm. Fl. So. States, ed. 2, 671. 1883. (Not *L. elongatum* Sw.)

L. inundatum, var. *adpressum* Chapm. Fl. So. States, ed. 2, 671. 1883.

L. alopecuroides var. *elongatum* Chapm. Fl. So. States, ed. 3, 638. 1897.

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* The original description reads as follows: *β Bigelovii* (mihi): majus, ramis subramosis elongatis, foliis acuminatis sparsim denticulatis s. integris. *L. Carolinianum* Bigel. Fl. Bost. p. 384.

In the same paper *L. alopecurioides* (L.) follows as the var. *γ* of *Lycopodium inundatum.*

L. alopecuroides, var. *adpressum* Chapm. Fl. So. States, ed. 3, 638. 1897.

Stems prostrate and frequently rooting or slightly arching and rooting toward the end, 18–40 cm. long, simple or occasionally pinnately branching, thick (about 3 mm. in diameter): leaves 6–7 mm. long by 2 mm. broad, thicker and more rigid than in the last, lanceolate-acuminate, upwardly curving, the margin irregularly toothed, the teeth often compound below the middle of the leaf: peduncles 10–25 cm. long usually tall, slender (1.5–2.5 mm. in diameter), leafy with more or less appressed subulate-toothed leaves below and similar entire leaves above: strobiles narrow, about 3 mm. in diameter, and 1.8–7 cm. long: sporophylls 1 mm. × 5–6 mm. with a broad base, suddenly contracted above into a narrow subulate apex, usually more or less toothed near the base: sporangia subglobose.

Readily distinguishable from *L. inundatum* by the much thicker stems, toothed leaves, tall peduncles and long narrow spikes.

An abnormal condition occurs in which the strobiles fail to develop and the branches rise to an unusual height (35 cm.). Lake Worth, Florida, L. M. Underwood (U). One peduncle on the same sheet bears a strobile of unusual size (11 cm.)

In the northern part of its range, this plant is much smaller and is difficult to distinguish from *L. inundatum Bigelovii*, from which, however, it differs in its thicker stem, in the shape of its leaves, and in the degree of their denticulation which, however, is constant in the leaves of the prostrate stems, but the constancy frequently fails in the peduncular leaves.

Although the more southern plant is here regarded as a distinct species, and is believed to be entitled to such rank, it must be admitted that from the true boreal species, *L. inundatum*, to the large southern *L. adpressum* there are many forms which on account of variations in size of stem, denticulation and variations in the size and shape of leaf and sporophyll are difficult to place. It will, however, be found convenient to hold to the above arrangement as tentative in the hope that further and more careful field observations will help to clear up the whole matter. It is further of great interest to note that a single species which in Europe shows little variability is in America only a representative of a plexus of forms ranging from that species at one end of the series to the extremely curious plant, *L. alopecuroides*, at the other.

Specimens have been examined as follows :

MASSACHUSETTS: Plum Island, Newburyport, Oct., 1896, A. A. Eaton (U); Plymouth, Oakes (C, N).

RHODE ISLAND: Providence, July, 1892, J. F. Collins (N).

CONNECTICUT: New Haven, 1859, D. C. Eaton (C).

NEW YORK: Babylon, L. I., July and Sept., 1898, W. N. Clute (Y); Forbell's Landing, L. I., Oct., 1890, M. Timmerman (C).

NEW JERSEY: Hospitality Bridge, Aug., 1884, C. A. Gross (Y); Closter, Sept., 1865, C. F. Austin (U; C); Tom's River, July, 1898, W. N. Clute (Y); Ocean Co., Aug., 1889, N. L. Britton (C).

MARYLAND: Ammendale, May, 1897, G. A. Miller (N); Anne Arundel Co., Oct., 1894, and Sept., 1895, C. E. Walters (N); Branchville, Sept., 1899, W. R. Maxon (U).

DISTRICT OF COLUMBIA: near Washington, Sept., 1885, F. H. Knowlton (U).

VIRGINIA: Portsmouth, July, 1892, N. L. and E. G. Britton and A. M. Vail (C); Fredericksburg, Aug., 1893, T. C. Porter (C).

NORTH CAROLINA: Rowan Co., J. K. Small, Aug., 1894 (N, C); Southeastern N. Car., W. W. Ashe (N).

LOUISIANA: Lake Charles, Aug., 1897, S. M. Tracy (U).

ALABAMA: L. F. Ward, 1892 (N); Mobile, 1877, C. Mohr, (N).

GEORGIA: Sumter Co., Dec., 1895 and 1896, R. M. Harper (Y).

FLORIDA: Lake Worth, Mar., 1891, L. M. Underwood (U); Leesburg, 1891, L. M. Underwood (U); Jacksonville, Mrs. F. A. Curtis (U, G); Everglades, Mar., 1892, J. H. Simpson (N, G); "L. inundatum var. elongatum, S. Fl. ined." Herb. Chapman (N) (and similar sheet in C); Palma Sola Bay, Aug., 1890, J. H. Simpson (N); among these one specimen shows an entire absence of teeth on the leaves in one region of the stem, while the rest of the specimens on the sheet have normal leaves; the specimen looks as if it had grown partly submerged.

6. **L. pinnatum** (Chapman)

L. inundatum, var. *pinnatum* Chapman, Fl. So. States, ed. 2, 671. 1883.

L. alopecuroides, var. *pinnatum* Chapman, Fl. So. States, ed. 3, 638. 1897.

Stems pinnately branching, elongate (20–30 cm.) and very slender (1–2 mm.) with evident dorsiventral character: leaves (8–9 mm. × 1 mm.) thin, linear-lanceolate, slightly curved, long-toothed, those of the upper side smaller, all somewhat contracted at the base; those of the peduncles similar but more gradually tapering to the apex: peduncles 25–40 cm. long, slender (1–2 mm. in diam.), very leafy: strobiles 3–12 cm. long, 5 mm. thick, with spreading sporophylls, similar to the peduncular leaves, but longer and more gradually tapering: sporangia sub-globose.

This very distinct species was made first a variety of *L. inundatum* and later of *L. alopecuroides*, but its dorsiventral habit and other marked characters clearly distinguish it from both; it is very clearly recognized. The lateral expanse of foliage ranges from 16 to 18 mm. Very rarely the denticulation appears to be nearly absent, as in a specimen seen from Jacksonville, Fla.

Specimens have been examined as follows:

MISSISSIPPI: Jackson, July, 1896, C. L. Pollard (N); Ocean Springs, June, 1896, L. M. Underwood (U); Aug., 1889, F. S. Earle (U); Aug., 1898, S. M. Tracy (Y).

ALABAMA: Spring Hill, Aug., 1897, B. F. Bush, 159 and 151 (Y, N); Auburn, Oct., 1896, C. F. Baker (C).

GEORGIA: McIntosh Co., June, 1895, J. K. Small (C).

FLORIDA: "Damp Pine Barrens" in Jacksonville, Sept., 1896, A. H. Curtis, nos. 3788 (C, N), 5783 (G); S. Fla., Herb. Chapman (N, C).

7. L. ALOPECUROIDES L. Sp. Pl. 1102. 1753

Stems elongate (50 cm. or more), thick (3–4 mm.), with an arching habit, rooting near the end, the vertical peduncles arising from the arches, densely leafy: leaves (5–7 mm. × 0.6–1.2 mm.) thicker than in the last, lanceolate-acuminate, spinulose on the sides of the stem to linear lanceolate on the upper and lower side, margin long toothed, and the lower surface near the base usually very hairy, especially on sides of the stem: those of the peduncles similar: peduncles long (20–30 cm.) densely leafy and scarcely distinguishable from the stems: strobiles 2–10.5 cm. long, 5 cm. thick, when ripe with reflexed sporophylls, these similar to the peduncular leaves but not hairy on the underside, longer (10–11 mm.), more gradually tapering and similar to those of the last species.

A number of mature specimens we have seen lead us to believe that the reflexion of the sporophylls at maturity is a constant feature in this species, but not in *L. pinnatum*. Further field observations are necessary to establish or refute this belief.

Specimens have been examined as follows:

NEW YORK: Babylon, L. I., Sept., 1898, W. N. Clute (Y).

NEW JERSEY: Landisville, C. A. Gross (Y), Hospitality Bridge, Sept., 1887, C. A. Gross (N), Pines, C. F. Austin (C).

DELAWARE: Ellendale, Sept., 1891, W. M. Canby (N).

NORTH CAROLINA: Hendersonville, Sept., 1898, Biltmore Herb., 595A (Y); Wilmington "in *Dionaea* savannah," June 25, 1890, F. V. Coville (N).

SOUTH CAROLINA: Santee Canal, Sept., Ravenel (G).

MISSISSIPPI: Ocean Springs, June, 1896, L. M. Underwood (C), F. S. Earle, Aug., 1889 (U); Biloxi, Aug., 1898, S. M. Tracy (U).

ALABAMA: Spring Hill, Aug., 1897, B. F. Bush, 153 (Y N).

GEORGIA: Lowndes Co., June, 1895, J. K. Small (C); 1840, A. Gray (C).

FLORIDA: Jacksonville, "moist pine barrens," Nov., 1894, A. H. Curtis, no. 5357 (C); Lake Co., Aug., 1894, G. V. Nash (N, C); S. Fla., Chapman (N, C); Appalachicola, Aug., 1891, Chapman (N, G); Hibernia, March, 1869, W. N. Canby (G); T. W. Webster (Y).

The stems of the four species just described differ not a little in certain details of stem structure. Certain features they all possess in common with one exception, noted below; these are more especially the gum canals and air spaces which occur in the cortex. A single gum canal occurs on the outside of each leaf trace, and runs up into the leaf. The air spaces are irregular schizogenous cavities in the cortex; they are very small, are few in number in *L. inundatum* and are absent in *L. pinnatum*; in *L. adpressum* they are more numerous and larger than in *L. inundatum*, while in *L. alopecuroides* they attain their maximum development both in size and number. Indeed, the cortex in this handsome plant is little more than a honeycomb, the walls of which are composed of a single layer of parenchyma cells. All four species store up toward the end of the growing season a large amount of reserve food, for the most part starch, and as a result of this habit the terminal portions of their horizontal stems become considerably thickened. The stele is also enlarged in these parts, and the air spaces are very much reduced, more so in *L. alopecuroides*, however, than in the others. These terminal parts of the stems serve to perpetuate the plants during the winter. There is also not a little difference in the size of the stems, *L. pinnatum* having the smallest, with *L. inundatum* next in order; *L. alopecuroides* has the thickest stem of the four.

8. L. CAROLINIANUM L. Sp. Pl. 1104. 1753

Stems short (1–15 cm.), slender (1–1.5 mm. diam.), prostrate, pinnately branching, rooting occasionally from the under side; leaves strongly dimorphic, the apparently lateral ones large (5–6 mm. × 1.5–2 mm.), ovate-lanceolate, falcate, recurved, broadest below the middle, with a midrib asymmetrically placed, thin, entire, acute: leaves of the upper side smaller (3–4 mm. × 0.8–1 mm.), subulate with a broad base: leaves of the peduncles reduced to small (2–3 mm.) subulate more or less appressed bracts: peduncles 5–22 cm. long, slender, with few usually whorled or scattered bracts: strobiles (1–5 cm. long × 2–2.5 mm.) with sporophylls (2 × 3 mm.), these triangular or somewhat contracted above the base, margin entire or erose: *sporangia* subglobose.

Habitat: In wet places, swamps.

A plant with a very pronounced dorsiventral character, in which the apparently large lateral leaves are really leaves of the under side, giving it a superficial resemblance to a liverwort. Although similar in some regards to *L. inundatum* and *L. pinnatum*, it is to be separated from them by its above just described dorsiventral character.

Specimens from the United States have been examined as follows:

NEW JERSEY: Atsion, Aug., 1897, J. A. Allen (G); Leed's Point, 1833, A. Gray (G); Quaker Bridge (N); Toms River, 1894, L. H. Lighthipe (?); Egg Harbor, Sept., 1884, L. M. Underwood (U); Hospitality Bridge, Aug., 1883, C. A. Gross (strobile 1.5 cm. long) (Y); Toms River, July, 1898, W. N. Clute (Y).

NORTH CAROLINA: Wilmington (G).

SOUTH CAROLINA: Aiken, Ravenel (N).

GEORGIA: Sumter Co., June, 1897, R. M. Harper (Y).

MISSISSIPPI: Ocean Springs, 1896, C. L. Pollard (N).

FLORIDA: Apalachicola, July, 1891; Chap. Herb. (G); Appalachicola, 1856, Chapman (strobile 14 cm. long) (C); Jacksonville, A. H. Curtis, 1896 (G); Eustis, G. V. Nash, July, 1894, no. 1451 (G, C); Lake Worth, Mar., 1891, L. M. Underwood (U); Orange Co., July, 1894, S. L. Lewton (Y); T. W. Webster (strobile 14 cm. long) (Y).

The species also extends through the tropics to Brazil.

9. L. ANNOTINUM L. Sp. Pl. 1103. 1753

Prostrate stems a meter or more long, extensively creeping along the surface, very rarely pinnately branching, stiff, rooting, leafy, with frequent aerial branches 15–25 cm. tall, which fork 1–3 times or not at all, producing slender erect branches, which are usually strobile-bearing: leaves 5–8.5 mm. × 1–1.5 mm., in 8 rows, uniform in shape throughout the plant, longest in the aerial parts where they spread horizontally or are finally somewhat reflexed with upwardly curving apices, lanceolate to linear-lanceolate, broadest at or above the middle, serrulate, acute or pungent: strobiles sessile upon the leafy vertical branches, thick (4 mm. × 1–3 cm.), with broadly ovate sporophylls, the latter with erose margins and subulate tips.

The so-called var. *pungens* with stiffer, shorter more erect leaves is a condition not at all confined to mountain forms.

Distribution: Alaska, Washington, Idaho, Montana, Lake Winnepeg, Colorado, Minnesota, Michigan, Pennsylvania, New York, Massachusetts, Vermont, New Hampshire, Maine, Newfoundland, Greenland.

10. L. CLAVATUM L. Sp. Pl. 1100. 1753

Prostrate stems 1–4 meters long, creeping extensively along the surface of the ground, very leafy, sparingly rooting, branching horizontally, with frequent aerial stems which are immediately ascending or at first prostrate, then ascending, producing pinnate branches of the second and third order, lax, some of them producing stout peduncles, 7–12 cm. long, with subulate, bristle-tipped whorled or scattered bracts and producing one, or frequently 3–4 strobiles: leaves linear or somewhat expanded at the middle, acute, denticulate, bristle-tipped, entire or minutely denticulate, those of the horizontal stems strongly denticulate: strobiles with deltoid sporophylls, erose, subulate tipped: sporangia reniform.

A widespread species or complex of species extending according to Baker's treatment* throughout the arctic and alpine zones of both hemispheres and in the mountains of tropical Asia, Africa and Polynesia. He reduces nine species under this name several of which will be found to be distinct. Some of the specimens from the Northwest and Alaska are very unlike the eastern forms and usually have much more forked strobiles and are commonly devoid of bristle tips to the leaves. In some particulars they resemble the east Asiatic and Siberian forms with larger suites of which they should be compared than are available in this country. Meanwhile careful field notes of the forms occurring from Oregon northward to Alaska are desirable.

Distribution: Labrador, Newfoundland, Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, Pennsylvania, Quebec, Ontario, Michigan, Wisconsin, Minnesota, Saskatchewan, Oregon, Washington, Alaska.

A large proportion of the material from the Northwest which has been examined differs materially from the eastern plant, the most striking feature being the absence of the bristle tip to the leaf. Plants from Alaska show a dwarfed condition, with shorter peduncles. The distribution of the plant in the Northwest is of interest and is shown here in more detail:

WASHINGTON: In damp woods, 4000–5000 ft. alt., Skamania Co., Aug. 28, 1890, W. N. Suksdorf, no. 1030 (C, G, N); 1889, G. R. Vasey, no. 32 (N, G); deep woods, Pierce Co., Aug., 1895, C. V. Piper (G); forest, Mt. Rainier Range, U. S. South Pac. Exp. Exped., 1838–42, Klickitat Pass, F. E. Lloyd (Y).

OREGON: Base of Mt. Hood, Nov., 1870, G. Howell (G); Bridal Vail, Aug., 1897, J. E. Kirkwood (Y).

BRITISH COLUMBIA: Mt. Benson, N. I., July 10, 1893, J. Macoun (N); 1859, Lyall, no. 1318 (C).

ALASKA: 1879, C. M. Turner (N) and 1881 (G); Kadiak Is., June 27, 1896, B. J. Bretherton (N).

The Mexican and Central American representatives of this species differ in having stems which merge into the peduncles as shown by the gradual reduction of the leaves from the typical foliar condition to that of small bracts, or, again, the peduncles may be entirely leafy. This is probably due to the influence of less abrupt seasonal changes. The forkings of the peduncles are sometimes more distant, and the whole plant has a more lax habit. Specimens have been examined from the following localities:

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* Handbook of Fern Allies, p. 26.

JAMAICA: Blue Mt. Peak, Dec. 14, 1890, A. S. Hitchcock (U); 1885 (N).

MEXICO: Orizaba, 1853 (C), Jalapa; Vera Cruz, 4000–5000 feet, Dec., 1894, C. L. Smith, no. 2119 (N); Orizaba, 1855 Müller, no. 362 (C); Manzanilla, Mt. Chiapa, 2000 meters, Aug., 1890, J. N. Rovirosa (C).

GUATEMALA: San Miguel Uspantán, Quiche, 7000 feet, April, 1892, Heyde and Lux (C, N).

NICARAGUA: 1853–6, C. Wright (N).

11. L. OBSCURUM L. Sp. Pl. 1102. 1753

L. dendroideum Michx. Fl. Bor. Am. **2**: 282. 1803.

Horizontal stems extensively creeping undergound, giving off single vertical stems which by repeatedly branching produce a bushy mass of foliage 12–25 cm. high: leaves spreading and upwardly curving, linear-lanceolate and twisted, especially above so as to lie in a vertical plane, acute, mucronate, on the lower branches in 8 rows, on the terminal in 6 rows; strobiles sessile: sporophylls broadly ovate, papery and erose-margined, acuminate with a subulate apex: sporangia reniform.

The form with a tendency to dorsiventrality in the terminal branches the upper and lower rows of leaves being shortened and appressed, is supposed to be the one to which the Linnaean name was originally given. It is unfortunate that Michaux's appropriate name could not hold for this miniature tree-like species.

Distribution: Newfoundland, Maine, Quebec, Ontario, New Hampshire, Vermont, Massachusetts, Connecticut, New York, New Jersey, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, Kentucky, Tennessee, Ohio, Minnesota, Michigan, Montana, Alaska.

12. L. CERNUUM L. Sp. Pl. 1103. 1753

Stems 20–35 cm. long, procumbent or arching, with clustered roots at points of contact with the ground, branching often in different planes, the terminal branchlets often strobile-bearing and nodding: leaves 3–5 mm. long, cylindric, slender, subulate, spreading and upwardly curving: strobiles sessile, 5 mm. long, with small sporophylls (1.5 mm. × 8 mm.) ovate-acuminate, thin with deeply fringed margins: sporangia minute, spherical, transversely compressed.

The plant of the Gulf region seems to differ in no respect from the more tropical form except in size, in the less pronounced upright habit, and in the length of the strobiles.

Specimens from the United States have been examined as follows:

MISSISSIPPI: Ocean Springs, July, 1889, F. S. Earle (U).

ALABAMA: "Springy clay banks," Mobile Co., June, 1889, C. Mohr (U, G, N); Spring Hill, "common in swamp," Aug., 1897, B. F. Bush (Y).

FLORIDA: Lake City, Dec., 1894, F. C. Straub, no. 42 (G); Prairie Creek, A. P. Garber (C, G, N); "moist pine barrens," near Jacksonville, Mrs. A. Curtiss (G); E. Fla., Chapman (G); Waldo, Jan., 1871, Chapman (C); Oneco, Dec., 1897, E. W. Reasoner (U).

Widely distributed through the tropics.

13. L. SITCHENSE Ruprecht. Beitr. z. Pflanzenk. d. Russ. Reich. 3: 30. 1845

Prostrate stems, 20–30 cm. long, creeping along the surface of the ground or a little buried, occasionally branching and rooting with scale-like leaves, sending up frequent aerial stems which branch dichotomously several (4–6) times to form compact masses of vertical terete branches, 5–7 cm. high, with occasional stronger strobile-bearing branches usually projecting above the tuft: leaves 2 mm. × 5 mm., lanceolate with a broad base, spreading and curving upward, thick, entire, acute, excurrent, in five rows on the branchlets; peduncles short (less than 1 cm.), very slender, with a few minute subulate bracts, or none, the strobiles then being sessile upon strong leafy branches: strobiles (0.8 × 2.5 cm.) with broadly ovate sporophylls with erose margins and long acuminate to subulate apices nearly equaling the sporophyll.

This form has been confused with *L. sabinaefolium* Willd. and Herr Ernst Pritzel, who has kindly examined Wildenow's type sheet for us at Berlin, and has sent some fragments of the sterile branches from the two specimens it contains, assures us that both this plant and what we here regard as true *L. sabinaefolium* are a part of Willdenow's original material from which he doubtless drew the description of *L. sabinaefolium.* The description of the latter with its expression "foliis lanceolatis acutis quadrifariis" indicates clearly the form Willdenow had in mind in naming the plant.

The plants of the Northeast are usually somewhat more slender and delicate in habit, with short (2–5 mm.) peduncles. The strobiles are sessile upon stronger leafy branches in the Northwestern forms; these leafy branches may readily be mistaken for peduncles.

Specimens have been examined as follows:

ALASKA: Back Bay, July 28, 1895, M. W. Gorman (N); Yes Bay, Aug. 21, 1895, T. Howell, no. 1730 (N), 1732 (Y).

BRITISH COLUMBIA: 49° N. Lat. Ore. Bound. Sur., Dr. Lyall, 1859. (G, lower specimen only.)

WASHINGTON: Mt. Rainier, 5000 ft., Aug., 1895, C. V. Piper (N, G); Lilly Lake, Chehalis Co., 2500 ft., Aug., 1897, F. H. Lamb, 1396 (Y); Olympic Mts., 5500 ft., C. V. Piper (G); Mt. Rainier, 1890, E. C. Smith (G); Mt. Adams, 7000 ft., Aug., 1885, W. N. Suksdorf (N); Stevens Pass, 1200 m., Aug., 1893, Sandberg & Leiberg (N U).

IDAHO: Lower Clark Fork, Oct. 7, 1895, 1820 meters, J. B. Leiberg (N).

ONTARIO: Magpie River, N. of Lake Superior, Aug., 1885, J. Macoun.

NEW YORK: Adirondack Mts., C. H. Peck (U).

MAINE: Mt. Ktaadn, Aug., 1892, S. O. Briggs (G); St. Francis, dry knoll in pasture, Aug. 7, 1893, M. L. Fernald, no. 215. (G, a good specimen with three strobiles.) (N, a smaller sterile specimen.) (U, one strobile.) Fort Kent, dry hillside pastures, June 15, 1898, M. L. Fernald (G).

LABRADOR: Square Island, Lat. 52° 44′ N., Aug. 1882, J. A. Allen (C); St. Michaels, 1891, A. C. Waghorne (N, C).

14. L. SABINAEFOLIUM Willd. Sp. Pl. 5: 20. 1810

Prostrate stems creeping along the surface, occasionally branching and rooting, with numerous aerial stems which soon branch 3–4 or 5 times to form a loose clump of erect or straggling dorsiventral branches: leaves 1.5–2 mm. long, subulate, slightly spreading, curved upwards, with thin apices, in four rows on the flattened terminal and subterminal branchlets, those of the lateral rows thicker and more curved than those of the upper and lower rows: peduncles (1–5 cm. long, 1 mm. thick) produced from stronger terete branches with their subulate bracts whorled or scattered: strobiles 2–3 cm. long, with broadly ovate sporophylls with short acute apices: sporangia reniform.

Specimens have been examined as follows:

MAINE: Fort Kent, "in shade," June 15, 1898, M. L. Fernald (G); Dover, "dry woods," Sept. 11, 1894, M. L. Fernald (G).

ONTARIO: Peninsular Harbor, "barren, open prairie," Sept. 16, 1896, G. S. Miller, Jr. (G).

PRINCE EDWARD ISLAND: Brackley Point, Aug., 1888, J. Macoun (U); Stanhope Road, Sept. 5, 1888, J. Macoun (C).

VERMONT: Rochester, "cold, mountain woods," Oct., 1892 (U, G); "cold, evergreen woods," Sept. 23, 1894, W. W. Eggleston (G, C).

15. L. CHAMAECYPARISSUS A. Br.; Doell. Rhein Fl. 36. 1843

16. L. COMPLANATUM L. Sp. Pl. 1104. 1753

These two species have been recently discussed and illustrated. *Cf.* Bull. Torr. Club, **26**: 559–567, *pl. 370*, 15. N. 1899.

The northwestern forms of *L. complanatum* lack the regular compact fan-like habit of the eastern plant, but spread loosely and irregularly and are apparently glaucous. The strobiles are often solitary and in the dwarfed arctic forms of Alaska are very small upon much reduced peduncles. There are, however, at present only insufficient reasons for giving distinct specific rank to these plants. *L. complanatum*, as it grows in Scandinavia, seems to parallel the northwestern condition of the American plant.

Material has been examined as follows:

LAKE SUPERIOR: (No. 22407).

MONTANA: Upper Flathead River, July, 1883, Canby no. 399 (G); MacDonald Lake, Aug., 1892, R. S. Williams (N).

IDAHO: Lake Pend d'Oreille, Sandberg, MacDougal and Heller, July, 1892 (Y, N); Heller, 770 (G).

WASHINGTON: Stampede Pass, Henderson, June, 1892 (G).

NORTHWEST TERRITORY: Red Deer River, 53° N. Lat., July, 1881, J. Macoun (G); Head of Yukon River, June, 1883, Schwatka (G).

ALASKA: Lake Lindeman, May, 1898, R. S. Williams. A very much stunted plant 5 cm. high with strobile 1 cm. long. Specimens identical with these have been collected by Wm. Palmer in Labrador, Aug., 1887 (N).

The Mexican and Central American forms are much taller, more lax, spreading, with more irregular habit. They have been variously referred to *L. complanatum* and *L. thyoides* H. & B. (originally described from Venezuela). Without a larger array of material we hesitate to separate these plants from *L. complanatum*.

17. L. ALPINUM L. Sp. Pl. 1104. 1753

Prostrate stems (20–50 cm. long), creeping at or near the surface of the ground; aerial stems numerous and branching several times to form dense clumps (4–8 cm. high) of markedly dorsiventral branches with glaucous foliage; occasional strobile-bearing branches (the so-called peduncles) thicker, terete and usually projecting above the general mass: leaves of the strobile-bearing branches subulate, those of the purely vegetative branches trimorphic, those of the upper row narrowly ovate, acute, those of the lateral rows thick, with one nerve asymmetrically placed, laterally truncate, acute, falcate, curved toward the under side, those of the under row trowel-shaped: strobiles sessile (1–2 cm. long), with ovate acute sporophylls: sporangia reniform.

This plant varies not a little in the amount of spreading of the lateral leaves, although the characters otherwise are very constant. It is the most highly specialized plant of the whole genus.

Specimens have been examined as follows:

ALASKA: Disenchantment Bay, Aug., 1892, F. Funston (N); July, 1879, L. M. Turner (N); Bischoff (N); Yakutat Bay, Aug., 1892, 1175 M. F. Funston (G, C); Juneau, Aug., 1891, 3000 feet. Grace E. Cooley (C); Unalaska, July, 1872, M. W. Harrington (N, C, G), Oct., 1871 (G), Dr. Mertens (G).

BRITISH COLUMBIA: Cascade Mts., Ore. Bound. Comm., Dr. Lyall, 1859 (G upper specimen only), Griffin Lake, Aug., 1889, J. Macoun (U).

GREENLAND: Sakkertappen, July, 1886 (G); Frederickshaad, Aug., 1886; Kolderup-Rosenvinge (G).

Additional species from tropical North America are represented in American collections examined as follows:

18. L. REFLEXUM Lam. Encyc. Meth. Bot. **3**: 653. 1789

MEXICO, *Vera Cruz:* Müller, 363 (C); Ex-Schlechlendal (C).
GUATEMALA: Tuerckheim (N); J. D. Smith, 504 (C, N).
NICARAGUA: Wright, 6 (N).
CUBA: Wright, 953 (C).
JAMAICA: Wilson (C); Ex-Bot. Garden (N).
PUERTO RICO: Sintenis, 6345 (N, Y).
GUADELOUPE: Perrin (C).

This species is a close ally of *L. lucidulum.*

19. [L. RIGIDUM Gmel. Syst. Nat. **8**: 1289. 1796

Reported from mountains of Martinique and Guadeloupe, but not found in American collections.]

20. L. VERTICILLATUM L. fil. Suppl. 448. 1781

L. setaceum Lam. Encyc. Meth. Bot. **3**: 653. 1789.
L. acerosum Sw. Fl. Ind. Occid. **3**: 1575. 1806.

The type was described from Bourbon, but Old World material in our herbaria is insufficient to verify or disprove the above quoted citations.

MEXICO, *Vera Cruz:* Müller, 361 (C); *Oaxaca:* Pringle, 4994 (C, N).
CUBA: Wright, 935 (C, N).
MARTINIQUE: Pere Duss (Y).

21. L. FUNIFORME Chamisso; Spring Monog. **1**: 50. 1842

CUBA: Wright, 943 (C, N).

22. [L. MOLLICOMUM Mart.; Spring Fl. Bras. **1**: 113. 1840

Reported from Guatemala, but not seen in American collections.]

23. L. LINIFOLIUM L. Sp. Pl. 1100. 1753

MEXICO, *Vera Cruz:* Müller (C).
GUATEMALA: J. D. Smith, 959 (C).
CUBA: Wright, 934, 1825 (C, N).
PUERTO RICO: Sintenis, 1541 (N, Y); Eggers, 8654.

24. L. DICHOTOMUM Jacq. Hort. Vind. **3**: 26. *pl. 45.* 1776

MEXICO, *San Luis Potosi:* Pringle, 2976 (C, N, U), (distributed as *L. taxifolium*).

CUBA: Wright, 944 (C, N).

25. L. TAXIFOLIUM Swz. Fl. Ind. Occid. **3**: 1573. 1806

MEXICO, *Vera Cruz:* C. L. Smith, 2118 (N); Cordoba, Bourgeau (C). *Morelos:* Pringle, 7613.

CUBA: Wright, 937 (C, N).

JAMAICA: Caswell Grave, 3206; Ex Bot. Garden (N).

PUERTO RICO: Sintenis, 1538 (N, Y).

SANTO DOMINGO: Pere Duss (Y).

GRENADA: Sherring, 36 (C).

26. L. AQUALUPIANUM Spring, Monog. **1**: 68. 1842

CUBA: Wright, 936 (C).

PUERTO RICO: Sintenis, 5432 (N, Y).

TRINIDAD: Fendler, 107 (N).

27. [L. SUBULATUM Desv. Encyc. Bot. Suppl. **3**: 544. 1813

Reported from "all tropical America" but not seen in American collections.]

28. L. JUSSIAEI Desv. Encyc. Bot. Suppl. **3**: 543. 1813

JAMAICA: Purdie (C); Ex Herb. Bot. Gard. (N).

29. **Lycopodium Fawcettii** sp. nov.

Horizontal stems trailing giving off at intervals of 2–3 cm. lax clusters of much branched aerial stems (12–15 cm. high) of two sorts, vegetative and peduncular; the vegetative branches flattened, the ultimate divisions elongate slender and rigid (1.5 mm. wide) with four rows of appressed leaves, those of the under row reduced to a triangular tip; peduncular stems arising from near the ground, branching about six times, thick, terete, the ultimate branches the thinnest with 6–8 rows of triangular, thin, membranous tipped leaves; many of the peduncular stems produce ultimately sessile strobiles 2–3 cm. long which scarcely exceed the negative branches, sporophylls broader than long, very abruptly contracted into a subulate tip, sporangia reniform.

JAMAICA: ex herb. Botanical Garden, 1885 (N) (U. S. Nat. Herb 22368=type); Wilson, 1863 (C), a form with abnormal peduncular stems.

SANTO DOMINGO: Wright, Parry, and Brummel, no. 37, 1871 (N, C). Apparently a much more elongate and slender form; Eggers, no. 2270 (C), similar to Wilson's Jamaica form noted above.

This plant is related to *L. complanatum* but is entirely distinct from that species.

Explanation of Plates

PLATE 2

All the figures are drawn to the same scale.

FIG. 1. *Lycopodium sabinaefolium.* A portion of a branch, showing the spreading and incurved lateral leaves.

FIG. 2. The same, lateral view. The leaves of the upper and lower rows are seen to be equally developed and spreading.

FIG. 3. *L. alpinum.* Under side of a part of a branch.
FIG. 4. Lateral view of the same.
FIG. 5. *L. Sitchense.* A portion of a branch. Leaves in five rows.
FIG. 6. *L. porophilum.* Sporophyll with sporangium.
FIG. 7. " Leaf.
FIG. 8. *L. Selago.* Leaf.
FIG. 9. " Leaf.
FIG. 10. " Sporophyll.
FIG. 11. *L. lucidulum.* Sporophyll.
FIG. 12. " "
FIG. 13. " Leaf.

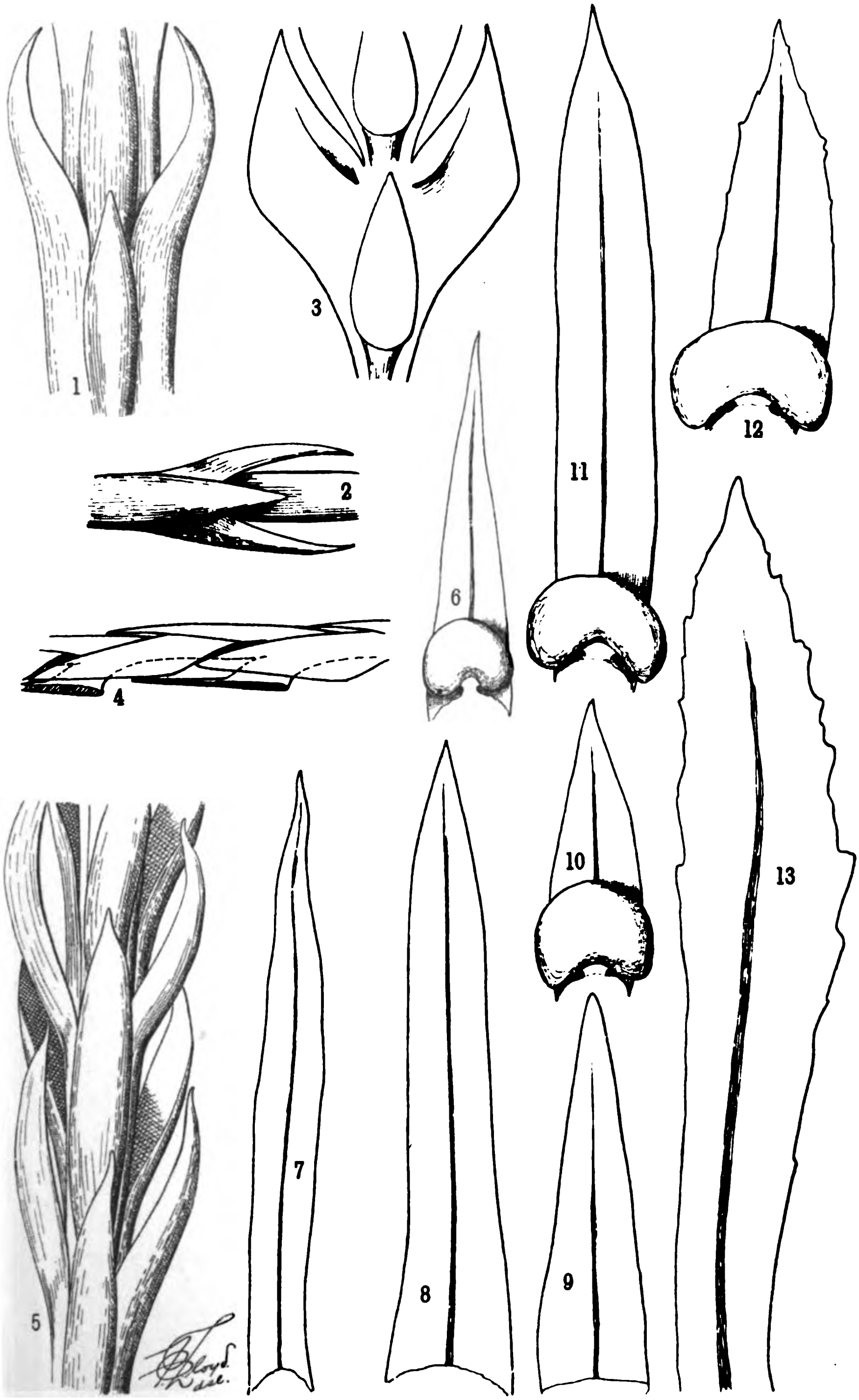
PLATE 3

FIG. 14. *L. adpressum.* Transverse section of stem through hibernating region.
FIG. 15. " Transverse section of stem.
FIG. 16. " Leaf.
FIG. 17. " Leaf from peduncle.
FIG. 18. " Sporophyll.
FIG. 19. *L. alopecuroides.* Transverse section of stem.
FIG. 20. " Transverse section of stem through hibernating region.
FIG. 21. " Leaf.
FIG. 22. " Sporophyll.
FIG. 23. *L. inundatum.* Leaf.
FIG. 24. " Leaf.
FIG. 25. " Sporophyll.
FIG. 26. " Transverse section of stem.
FIG. 27. *L. pinnatum.* Transverse section of stem.
FIG. 28. " Leaf.
FIG. 29. " Sporophyll.
FIG. 30. " Leaf.

PLATE 4

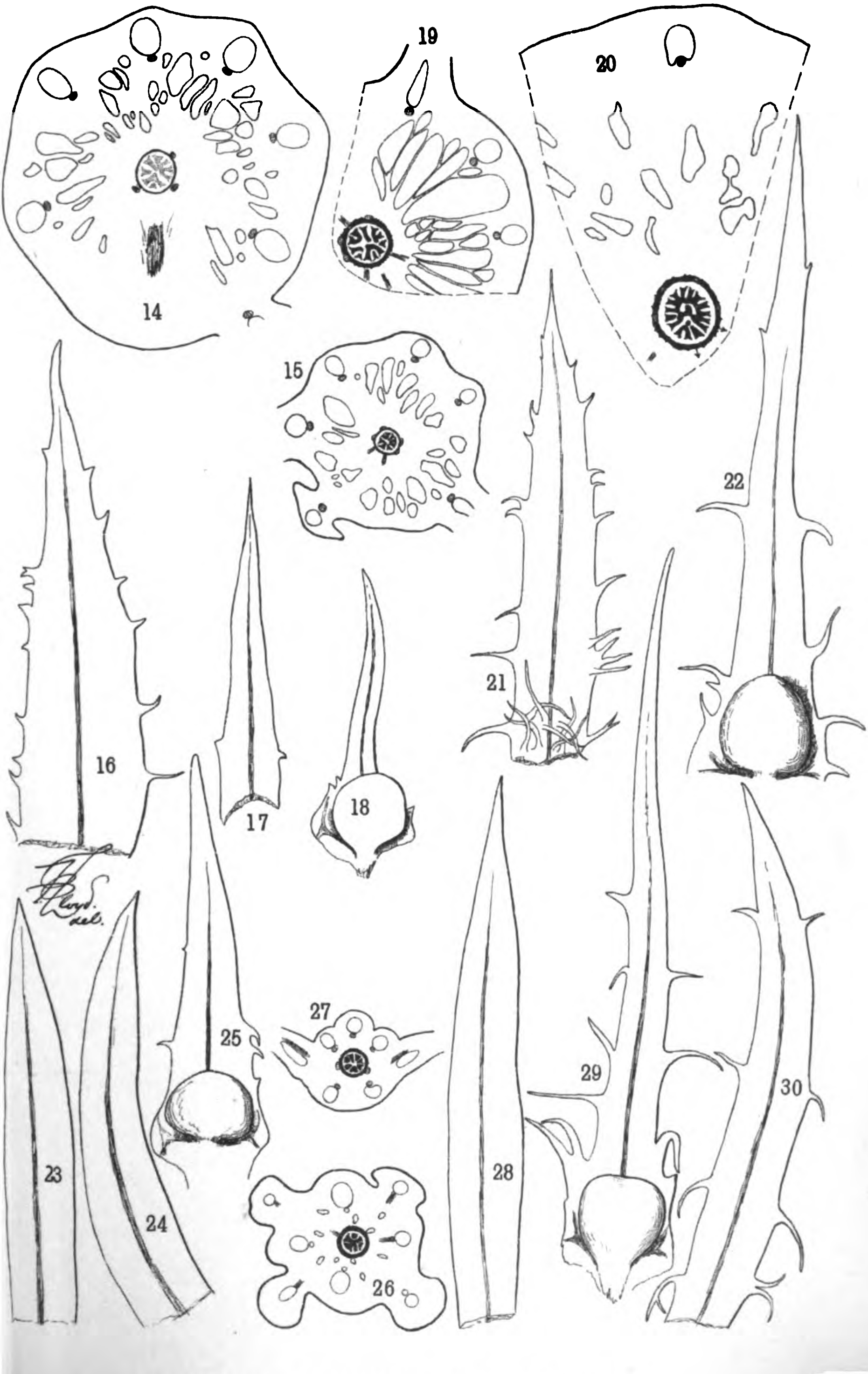
L. pinnatum and *L. alopecuroides* from the Chapman Herbarium (C); the former representing Chapman's type specimen.

168-1

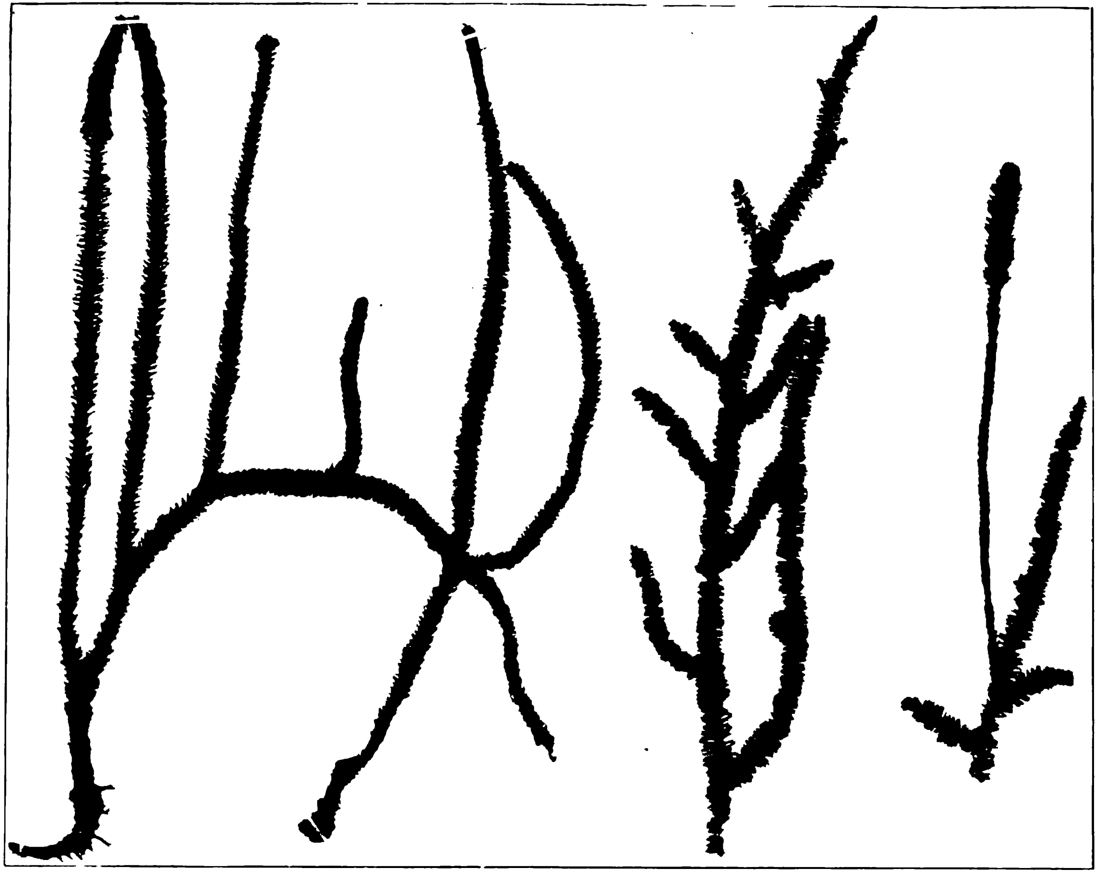


LLOYD AND UNDERWOOD ON LYCOPODIUM.

168-2



LLOYD AND UNDERWOOD ON LYCOPODIUM.



LYCOPODIUM ALOPECUROIDES AND LYCOPODIUM PINNATUM.

The Publications of the Department of Botany, Columbia University, consist of Memoirs in quarto and Contributions in octavo.

The Memoirs already published are:—

Vol. I. **Small.** A monograph of the North American species of the genus *Polygonum.* pp. 178. 84 plates. 1895. Price, six dollars.

Vol. II. **Rydberg.** A monograph of the North American Potentilleæ. pp. 224. 112 plates. 1898. Price, six dollars.

The Contributions have now reached the seventh volume.

Vol. I. Nos. 1–25 (1886–1892). Out of print, except Nos. 6, 7, 11, 17, 20, 21, 22, 24. These can be supplied at twenty, five cents each, except No. 6, which is one dollar.

Vol. II. Nos. 26–50 (1892–1894). Nos. 26, 28, 29, 32, 33, 34, 36 39 and 48 are out of print. Other numbers can be supplied at twenty-five cents each, except No. 35, which is one dollar and a half.

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Vol. VII. No. 151—(current).

Lists of titles of Contributions may be had on application.

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 170

STUDIES IN SISYRINCHIUM—VII: THE SPECIES OF BRITISH AMERICA

BY EUGENE P. BICKNELL

NEW YORK
1900

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[Reprinted from the BULLETIN OF THE TORREY BOTANICAL CLUB, 27: May, 1900.]

Studies in Sisyrinchium.—VII: The Species of British America

BY EUGENE P. BICKNELL

The examination of our larger collections of blue-eyed grasses has disclosed few specimens from north of the United States other than those contributed by Prof. John Macoun. For this reason it was a matter of the greatest interest to receive recently from Professor Macoun his entire British American collection or, more exactly, some thirty-three sheets representing the general result of many years of field-work covering the wide range of British American territory from Newfoundland to Vancouver. This collection, supplemented by such other material as has been brought together, presents so much that is new, especially in regard to the range of our species, that it has seemed well to make it the subject of a separate paper.

It should be said that the genus *Sisyrinchium* is here taken in a somewhat restricted sense to embrace only the homogeneous and very natural group of the blue-eyed grasses proper, thus excluding *Sisyrinchium grandiflorum* Douglas, which is clearly the type of a distinct genus, as recognized by Rafinesque, and should stand as *Olsynium Douglasii* (A. Dietr.), and omitting further the more closely allied yellow-flowered genus *Hydastylus* Salisbury, typified by *Sisyrinchium Californicum* Aiton.

As thus limited it appears that eight species of *Sisyrinchium* may be ascribed to British America and there is no doubt that this number may be increased. Certain more or less distinct forms of several of the species might, even now, be recognized but are passed over. It is further altogether probable that several northwardly ranging species of the United States cross over into Canadian territory and there is also evidence that new species yet remain to be discriminated.

The species which may be recognized at the present time as British American are the following, noting them from east to west:

S. graminoides Bicknell.
S. angustifolium Miller.
S. albidum Raf.
S. mucronatum Michx.
S. septentrionale Bicknell.
S. Idahoense Bicknell.
S. littorale Greene.
S. Macouni sp. nov.

Of these all but *S. littorale* and *S. Macouni* belong also to the United States, though *S. septentrionale* is all but exclusively British American.

Other species known to occur in states adjoining Canadian territory are the following:

S. Atlanticum Bicknell, Maine (North Berwick, York Co., June 21, 1891, J. C. Parlin, in Herb. Gray, not previously recorded from the state); New Hampshire; Vermont.

S. arenicola Bicknell, Nantucket; New York.

S. hastile Bicknell, Michigan.

S. Farwellii Bicknell, Michigan.

S. strictum Bicknell, Michigan.

S. apiculatum Bicknell, Michigan.

S. campestre Bicknell, Minnesota; North Dakota.

S. occidentale Bicknell, North Dakota; Montana; Idaho.

S. segetum Bicknell, Washington.

S. sarmentosum Suksdorf, Washington.

SISYRINCHIUM GRAMINOIDES Bicknell

This species is of interest as being the only normally branched species occurring north of the United States. Since it there extends northward to central and western New York and throughout the southern peninsula of Michigan its occurrence in the southwestern extremity of Ontario was to be expected, and it is only surprising that a single specimen alone attests its presence there. Elsewhere in Canada the plant was scarcely to be looked for and it is a matter of no little surprise to find it as far north and east as the coast of Gaspe in Quebec and on Newfoundland and Sable Island. These occurrences afford a most unexpected extension of range as the species appears to be unknown elsewhere in Canada east of Ontario nor in New England beyond eastern Massachusetts.

The specimens from Ontario and Gaspe are perfectly typical, while those from Newfoundland and Sable Island show departures from the ordinary plant so considerable as to give them some rank as insular forms. Indeed the Newfoundland plant would scarcely be taken at all for *S. graminoides* and has been distributed as *S. angustifolium* Miller (Robinson's & Schrenck's Flora of Newfoundland, No. 129) to which species I had myself doubtfully referred it (Bull. Torr. Club, **26** : 339).

A number of sheets of the distribution show the plant to be mostly only 6–10 cm. high, and simple-stemmed with somewhat prolonged outer bract, thus closely simulating S. *angustifolium.* It is, however, clearly a much reduced northern or insular form of S. *graminoides,* drying dark as in that species, and showing the weak and narrow proper stem and relatively broad thin rings with closely serrulate edges, and also its thin-walled sub-globose capsules or spreading pedicels. The leaves are also those of that species, unmistakably so in a few stouter examples where they become 4 mm. wide, although mostly not exceeding 1–1.5 mm.

The tendency of this little plant to develop more clearly the characters of S. *graminoides* is shown by two examples collected with the others which are three to four times taller and forked into two slender branches. These specimens show the extreme form of attenuation seen in the mainland plant and are nearly matched by the specimens from Sable Island, where Professor Macoun reports the plant as common. It is there uniformly very slender, the stems and leaves being but 1–2 mm. wide, and appears to have unusually small capsules, unlike the Newfoundland plant on pedicels scarcely spreading or exserted. It differs further from the latter in larger size (15–30 cm. high) rather broader spathes with less prolonged outer bract and in slenderly branched stem, only a few examples having the stem simple.

In Gaspe and Newfoundland, at the extreme northeastern limit of its habitat, this, the widest-ranging of all our species except S. *angustifolium,* flowers from late in July till the end of August, three to four months later than in the Gulf States, two to three months later than in the South Atlantic States, except at high altitudes, and one to two months later than in the latitude of New Jersey. In northern Michigan the species is equally late flowering. In Ontario it appears to flower about the same time as in central New York, and two or three weeks later than in southern Michigan and New Jersey.

The following specimens may be cited :

SABLE ISLAND : July 22, 1899, in flower; Aug. 4, 1899, immature fruit. John Macoun.

NEWFOUNDLAND: Banks of the Salmonier River, Aug. '26, 1899, B. L. Robinson and H. Schrenck, no. 129, Flora of New-foundland, nearly mature fruit and some remaining flowers.

QUEBEC: Coast of Gaspe, Aug. 12, 1882, moist meadows, John Macoun; in flower and with young fruit.

ONTARIO: Near Niagara Falls, June 25, 1892, in grassy woods, John Macoun; flowers and young fruit.

SISYRINCHIUM ANGUSTIFOLIUM Miller

This is the most characteristic and generally distributed species of British America, ranging from Newfoundland quite across into British Columbia and north to the Mackenzie River. No eastern specimens have come to hand from farther north than Newfoundland and Riviere du Loup, Quebec. I have elsewhere pointed out that specimens from west of Ontario differ in some rather striking particulars from the more eastern plant, being stiffer and more glaucous with the edges of leaves and stem often quite smooth and with leaves of thicker texture and closer venation and with the primary bract usually more slenderly prolonged. Eastern specimens often show a discoloration on the herbarium sheet in marked contrast with most western examples. It is quite possible that these differences point to two distinct species which a full series of specimens with well-preserved flowers and mature fruit would make it possible to segregate. The western plant itself exhibits a great amount of variation, and certain specimens from Banff, Alberta, appear almost distinct. They are very glaucous and extremely slender and tall, becoming 50 cm. high with the narrow outer bract two to three times the length of the inner one, even becoming 6 cm. long; the slender pedicels become 28 mm. long, and are more than usually exserted; the flowers appear to be rather small and of very delicate texture with an unusual extension of the yellow center along the midvein of the segments.

The species crosses the Rocky mountains into British Columbia, extending further west than I have yet had it from the United States where Madison County, Montana (Rydberg), limits its western record as far as known.

In Newfoundland and Nova Scotia the species comes into flower from late in June till the middle of July, a month to six weeks later than in the neighborhood of New York, and earlier than *S. graminoides* by about the same length of time. In Ontario it comes into flower during the first half of June, while farther west, from Manitoba to British Columbia, the flowering period seems to be rather earlier, often beginning in the first days of June, or even before. The only example seen from as far north as the Mackenzie River was just in flower July 20th.

The following collections may be cited, all made by Professor Macoun unless not otherwise noted.

NEWFOUNDLAND: June 25, 1896, just in flower; July 12 and 15, 1897, in full flower, Rev. A. C. Waghorne.

NOVA SCOTIA: Louisburg, Cape Breton, July 17, 1883, moist meadows, just in full flower. Amherst Island, low grounds, July 30, 1880, just in flower, Richardson.

PRINCE EDWARD'S ISLAND: Brackley Point, meadows, July 3, 1887, full flower and young fruit; July 7, 1888, just in flower.

NEW BRUNSWICK: Campbellton, July, 1877, boggy meadows, R. Chalmers; St. John's River Valley, Woodstock, July 4, 1899, flowers and young fruit. Baie Vert, June 16, 1893, first flowers; Prof. W. L. Goodwin.

QUEBEC: Riviere du Loup, August 26, 1889, meadows, mature fruit, D. N. St. Cyr; Danville, June, 1894, first flowers, N. K. Berg; Montreal, F. W. Kelly.

ONTARIO: Belleville, June 16, 1876, moist meadows, first flowers; Jones Falls, June 11, 1895, fruit full size, J. Fowler; Nepigion River, July 7, 1884, moist meadows, fruit nearly mature; Toronto Island, June 10, 1893, full flower, C. W. Armstrong; Casselman, June 6, 1891, full flower, dampish ground, Jas. M. Macoun, Lambton, C. K. Dodge.

MANITOBA: Lake Winnipeg Valley, 1857, Bourgeau; Stonewall, June 2, 1896, full flower, amongst rocks, open prairie.

ASSINIBOIA: Moose Mountain Creek, June 6, 1883, first flowers, low ground, Jas. M. Macoun; Park Beg, June 23, 1896, fruit nearly mature, open prairie; Crane Lake, June 16, 1894, full flower, meadows.

SASKATCHEWAN: E. Bourgeau, 1858.

ALBERTA: Banff, July 14, 1891, flowers and young fruit.

BRITISH COLUMBIA: Kitamen River, Kootanie Valley, July

1883, fruit and last flowers, Dawson; Donald, Columbia Valley, July 7, 1885, fruit nearly mature; Lower Arrow Lake, June 4, 1890, first flowers. Latitude 54°, June 15, 1875, first flowers; "The exact locality is on the Machaco River, near Fort St. James, B. C." [J. M.].

MACKENZIE RIVER: Fort Wrigley, July 20, 1892, first flowers, Miss E. Taylor; the most northern point from which any species of the genus has been reported. Prof. Macoun writes: "Fort Wrigley is a new location, about half way between Fort Simpson and Fort Norman, on the right bank of the Mackenzie River, about latitude 63°."

SISYRINCHIUM ALBIDUM Raf.

This species must be admitted to the Canadian flora on the evidence of a single collection made at Sandwich, Ontario, by William Boott as far back as May 26, 1887. The specimens (Gray Herbarium) are in full bloom, thus showing the plant to be the earliest flowering of the British American species. The flowers are pale blue, as in most Michigan examples. Since the species is rather common in parts of southern Michigan, it is not surprising to find that it crosses the Detroit River into Ontario.

I have seen but a single specimen of this species from farther east—Stanley county, North Carolina (W. W. Ashe). Very possibly it may extend farther north and east in Ontario.

SISYRINCHIUM MUCRONATUM Michx.

Like *S. albidum* this species crosses the Detroit River into Ontario, having been collected at Sarnia, Lambton county, by Mr. C. K. Dodge in June, 1897. Specimens from farther north in the Province, Wingham, Huron county, have been distributed by Mr. J. A. Morton, collected in full flower June 5, 1895. Most specimens of this collection are much reduced and have very small pale green spathes and but little exserted pedicels only 10–15 mm. long. Mr. Dodge's specimens from Lambton county, have the spathes deep purple and are closely matched by examples from east Pennsylvania.

A material and most unexpected extension of the known range of the plant is afforded through a collection made at Prince Albert, Saskatchewan, by Professor Macoun, June 29, 1896. The specimens are in full flower and appear to differ in no material way from many Pennsylvania examples, having, however, rather long-bracted green spathes and with some of the pedicels more exserted than is usual and longer, 20–27 mm. in length.

The most northern and western point from which the species has been known hitherto is Port Huron, Michigan (C. K. Dodge).

Certain imperfect specimens of a *Sisyrinchium* from northern Minnesota, which I have elsewhere referred to under *S. angustifolium*, if not a distinct species may represent a stoutly developed form of *S. mucronatum*.

SISYRINCHIUM SEPTENTRIONALE Bicknell

Professor Macoun's collection affords a most interesting confirmation of the validity of this species previously described from only scant material. I am now able to record seven separate collections of the plant, giving it a range from western Manitoba north to Saskatchewan and west to British Columbia and Washington:

MANITOBA: west of Fort Ellice, June 29, 1879, flowers and young fruit, wet prairies, Macoun; east of Pipestone Creek, June 26, 1880, flowers and mature fruit, Macoun.

ASSINIBOIA: Moose Mountain Creek, June 16, 1883, full flower, low ground, Macoun.

SASKATCHEWAN: E. Bourgeau, 1858, Palliser's Brit. N. Am. Exploring Expedition.

ALBERTA: Banff, July 8, 1891, flowers and fruit, village street, Macoun.

BRITISH COLUMBIA: Kicking Horse River, Aug. 13, 1890, mature fruit, low gravelly banks, 4000 ft. alt., Jas. M. Macoun.

WASHINGTON: Wilkes' expedition, 1838–42, Spokane to Colville.

The specimens from Idaho elsewhere doubtfully referred here prove to be not this species.

Professor Macoun writes, "This is certainly a good species and seems to prefer drier situations than any of the others. To be more correct it seems to prefer arid spots where water has lain and dried up. Besides the specimens collected I saw it very frequently between Wood Mountain and the Rocky Mountains over

400 miles from east to west. Its white flowers make it easily seen although it is seldom tall."

The following particulars may now supplement the original description of this plant (Bull. Torr. Club, **26**: 452–3):

Plant becoming 35 cm. high, sometimes merely glaucescent: tufts often very close and narrow: primary bract sometimes 6 cm. long and surpassing the inner one 35 mm.: flowers frequently pure white: perianth 4–8 mm. long, column 3–4 mm. high: capsules obovoid-oblong to subglobose, usually thin-walled and corrugate: seeds very small, about .75 mm. in diameter, obovoid and irregularly angled, black, finely rugulose, becoming smooth or nearly so.

SISYRINCHIUM IDAHOENSE Bicknell

BRITISH COLUMBIA: Agassiz, May 8 and 14, 1889, full flower, meadows, Macoun; Lower Frazier River, 49° N. lat., Dr. Lyall, 1859; Vancouver Island, Victoria, June 10, 1893, full flower, Macoun; Nootka Sound, July, 1896, full flower, Jos. R. Anderson.

"This is the common species west of the Coast Range in British Columbia and on Vancouver Island" [J. M.].

The specimens from Agassiz and the Lower Frazier River are nearest to the Idaho type, but are more slender throughout, and with the leaves and stems smooth-edged or nearly so. The specimens from Nootka Sound are small and still more slender, appearing quite unlike the type, but they are imperfect and can be referred at present only to a reduced northern form. The specimens from Victoria are broader-leaved and more discolored besides having the stem distinctly serrulate. They are closely matched by certain specimens from western Washington and Oregon which are doubtless not the same as *S. Idahoense*, but while these latter differ notably from typical *S. Idahoense* in much stouter roots, the roots of the Vancouver plant are equally slender with those of the other British American specimens.

S. Idahoense is almost certainly an aggregate, but the component forms cannot be understood from present material.

It is worthy of note that the Agassiz plant appears to be earlier-flowering than the plant in Idaho, and also blooms decidedly earlier than does *S. angustifolium* anywhere in British America.

SISYRINCHIUM LITTORALE Greene

VANCOUVER ISLAND: Oak Bay, near Victoria, May 31, 1893, first flowers, Macoun.

The counterpart in appearance of many examples of the Alaskan plant, but apparently somewhat more glaucescent and with the stamineal column longer—7–9 mm. high as against a nearly uniform length of 6 mm. in such Alaskan specimens as have been examined. This difference is a suggestive one and its constancy should be especially noted when the plant is again collected.

"I cannot remember seeing this species anywhere else than at Oak Bay" [J. M.].

The Vancouver plant flowers about one month earlier than the species in Alaska.

Sisyrinchium Macounii sp. nov.

Becoming 50 cm. tall, the narrow grass-like tufts loosely disintegrate-fibrillose at base, the roots slender and nearly simple: pale dull green and glaucescent, somewhat discolored when dry. Leaves long and narrow, mostly 20–30 cm. long, 1.5–3 mm. wide, slenderly very acute, rather thin, the delicate nerves firm and distinct but not crowded, the edges smooth: stem single but sometimes bearing near the top a slender leaf subtending a simple peduncle, very slender, 1–1.5 mm. wide, with very narrow almost membranous margins, the edges smooth or obscurely denticulate-roughened towards the top, transversely constricted just below the spathe: spathes green or slightly purplish along the edges, often or usually abruptly deflected, long and narrow, the bracts thin and not prominently nerved; outer bract slenderly much elongated and tapering acute, 4–7 cm. long, surpassing the inner bract 1.5–4 cm., the extreme edge hyaline below, united-clasping for 4–7 mm. at base; inner bract 23–33 mm. long, tapering and slenderly acute, distinctly hyaline-margined, the keel often sparsely denticulate; interior scales silvery-white, tapering, short, about half the length of the inner bract: flowers large, few, apparently only 2–4, on slenderly exserted subspreading pedicels becoming 35 mm. long, perianth 18–22 mm. long, the emarginate segments very slenderly aristulate, deep purple with a very small yellow eye, the base abruptly broadened from its attachment on the ovary; stamineal-column 8–9 mm. high, anthers 2 mm. long.

"This species was not rare around Comox and was occasionally seen at Nanaimo and on the islands in the Gulf of Georgia" [J. M.].

VANCOUVER ISLAND: Comox, June 21, 1893, meadows, John Macoun.

Named in honor of Professor Macoun.

A handsome species, having the largest and most richly-colored flowers of any simple-stemmed species known to me. It is perhaps most nearly related to *S. segetum*, of Washington, but is much taller and larger, though relatively more slender, and differs notably from this, as well as from the stouter and paler-flowered *S. Idahoense*, in the greatly prolonged outer bract. Two specimens from Vancouver which appear to be reduced forms of this species are smaller flowered than the type with shorter bracts, the outer one much less elongated, and are suggestive of *S. segetum* or slender forms of *S. Idahoense*, although the type is clearly distinct from either. Professor Macoun writes further: "You are quite right in thinking this plant a striking species. Indeed so large were its flowers that I thought it was *S. grandiflorum* when I saw it first."

The Publications of the Department of Botany, Columbia University, consist of Memoirs in quarto and Contributions in octavo.

The Memoirs already published are:—

Vol. I. **Small.** A monograph of the North American species of the genus *Polygonum.* pp. 178. 84 plates. 1895. Price, six dollars.

Vol. II. **Rydberg.** A monograph of the North American Potentilleæ. pp. 224. 112 plates. 1898. Price, six dollars.

The Contributions have now reached the seventh volume.

Vol. I. Nos. 1–25 (1886–1892). Out of print, except Nos. 6, 7, 11, 17, 20, 21, 22, 24. These can be supplied at twenty, five cents each, except No. 6, which is one dollar.

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 171

NOTES ON THE FLORA OF MIDDLE GEORGIA

BY ROLAND M. HARPER

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Notes on the Flora of Middle Georgia

BY ROLAND M. HARPER

(WITH PLATE 22)

During part of three years spent at the University of Georgia, which is located in Athens, I had opportunity to make a somewhat extensive study of the interesting flora of that vicinity; and in the following notes I have brought together briefly some of the results of my observations on this flora. Although there have been other local botanists in Athens for many years, apparently no observations made since Elliott's time on this immediate region have been mentioned in botanical literature. In Elliott's Botany of South Carolina and Georgia (1816–1821) many plants, some of them types, are mentioned as having been collected in or near Athens by a Mr. Green, and I have been enabled to verify a number of Mr. Green's stations which had been overlooked by later authors after a lapse of nearly eighty years.

Athens, the county-seat of Clarke County, is situated in that section of the state known as Middle Georgia, a region well defined geologically from the two newer sections, north and south Georgia. Middle Georgia occupies about one third of the area of the state, and is distinguished by its geological formation being wholly Archaean or metamorphic. My botanical explorations of this region, in the spring and fall of 1895 and 1896, and the spring of 1897, were confined mainly to the western half of Clarke County, and portions of the neighboring counties of Jackson, Oconee, Walton and Morgan. This territory which I explored lies in the lower foothills of the Blue Ridge, being entirely south of latitude 34°N., and east of longitude 83° 31′W., and ranging from 500 to 800 feet above sea-level.

Taking Clarke County as typical of the surrounding region, its characteristic features of soil, topography, etc., may be briefly described. The predominating soil consists largely of red clay, derived from the disintegration of the granitic rocks which underlie the surface everywhere in this region and outcrop in many places, especially in the valleys. With the clay are mixed sand, organic matter, and numerous other constituents in proportions varying according to the local conditions.

Topographically, the country is quite hilly. The two branches of the Oconee River, known respectively as the Oconee and Middle Oconee, which traverse Clarke County from north to south, are joined by countless smaller creeks and "branches," and all these streams flow in rather deep and narrow valleys between broad rounded ridges.

The average annual temperature of Athens, which corresponds very closely with the average for middle Georgia, is about 63°F., with the following averages for the four seasons: spring, 62°; summer, 80°; autumn, 64°; winter, 46°. The average annual rainfall is about 55 inches, distributed among the seasons as fofows: spring, 14 inches; summer, 13 inches; autumn, 10 inches; winter, 18 inches.

It has been estimated that about one-half the area of Clarke County is covered with forest, of which one-fifth is original and four-fifths second growth. The adjoining counties, which are not so thickly populated, would no doubt show a larger proportion of forest. The original forest is now mostly confined to the steep sides of the valleys, while the second-growth is found on the more level land along the ridge-tops.

The flora of this region is quite similar in general character to that of the whole belt of country lying at the same elevation along the eastern slope of the Appalachian range from New England to Alabama. A comparison of the flora of Middle Georgia with that of southern New England shows that at least half of the species of each region are common to both. There is less similarity between the flora of Middle Georgia and that of South Georgia, which, although much nearer, belongs to an entirely different floral province.

In the cool shady primeval forests on the northern slopes of the ridges in Clarke and adjoining counties are found many species which are supposed to be strictly Alleghanian in distribution, some of which are mentioned below. On the other hand, the number of species which reach their northern limits in this region is very small. Of the species which I have collected in Middle Georgia, about 95% are known from the region of the northern manuals, and the remaining 5% are mostly either recently described or recently introduced, or species of very restricted range.

A little study of the plants of the region under consideration shows that they may be divided according to habitat into seven or eight well-marked principal groups. These groups overlap each other somewhat, but not as much as might be expected. In the following lists of plants I have prefixed an asterisk to those species which are mentioned in more than one list, to give some idea of the extent of overlapping.

Taking up the various floral areas in the order of their humidity, the swamps, bogs, meadows and marshes may be considered first. In the region about Athens these are of very small extent, owing chiefly to the narrowness and steepness of the valleys, and the number of hydrophytic species is correspondingly small. The following have been observed mostly in the meadows along Tanyard Branch in Athens and in the Sandy Creek marsh just north of the city:

**Selaginella apus* (L.) Spring.
Typha latifolia L.
Sparganium androcladum (Engelm.) Morong.
Potamogeton diversifolius Raf.
Alisma Plantago-aquatica L.
Sagittaria latifolia Willd.
Paspalum laeve Mx.
Homalocenchrus oryzoides (L.) Poll.
Eragrostis hypnoides (Lam.) B.S.P.
Cyperus flavescens L.
  strigosus L.
Kyllingia pumila Mx.
Eleocharis obtusa (Willd.) Schult.
  tenuis (Willd.) Schult.
  acicularis (L.) R. & S.
Scirpus lacustris L.
Carex lurida Wahl.
  vulpinoidea Mx.
**Peltandra Virginica* (L.) Kunth.
Juncus effusus L.
  dichotomus Ell.
  acuminatus Mx.
Polygonum sagittatum L.
Nymphaea advena Soland.
Ranunculus pusillus Poir.
Agrimonia parviflora Soland.
Callitriche palustris L.
Viola cucullata Ait.
Ludwigia alternifolia L.
Isnardia palustris L.
Lysimachia Nummularia L.
Hydrolea quadrivalvis Walt.
Lycopus Virginicus L.
Mimulus ringens L.
Gratiola sphaerocarpa Ell.
**Ilysanthes refracta* (Ell.) Benth.
Veronica serpyllifolia L.
Galium trifidum L.
Vernonia Noveboracensis (L.) Willd.
**Mikania scandens* (L.) Willd.
Eclipta alba (L.) Hassk.
Adopogon Dandelion (L.) Kuntze.

Eleocharis acicularis and *Scirpus lacustris* do not seem to have been reported from Georgia, at least within recent years, and they are probably rather rare in the state. I collected both in a small bog near the Middle Oconee River in Clarke County on May 28, 1897. The latter is mentioned in Dr. Feay's "Catalogue of Phaenogamous Plants growing spontaneously within thirty miles of Savannah, Ga." (Atlanta Med. Jour., 3: 167–217. 1860), but might have been collected in South Carolina.

Certain species, particularly trees and shrubs, seem to flourish best on river banks, and are rarely or never found in other situations. The following is a partial list of such species:

* *Uniola latifolia* Mx.
* *Danthonia sericea* Nutt.
Arundinaria tecta (Walt.) Muhl.
* *Uvularia sessilifolia* L.
Allium mutabile Mx.
* *Smilax rotundifolia* L.
Salix nigra Marsh.
Carpinus Caroliniana Walt.
Ostrya Virginiana (Mill.) Willd.
Betula nigra L.
* *Alnus rugosa* (DuRoi) Koch.
Fagus Americana Sweet.
Quercus nigra L. (*Q. aquatica* Walt.).
Ulmus Americana L.
Morus rubra L.
* *Liriodendron Tulipifera* L.
* *Ranunculus recurvatus* Poir.
Thalictrum polygamum Muhl.
Podophyllum peltatum L.
Calycanthus floridus L.
Arabis Canadensis L.
Platanus occidentalis L.
Philadelphus grandiflorus Willd.
Porteranthus trifoliatus (L.) Britton.
Pyrus angustifolia Ait.
Amelanchier Canadensis (L.) Medic.
Asimina triloba (L.) Dunal.
Ptelea trifoliata L.
* *Acer rubrum* L.
    Negundo L.
Tilia pubescens Ait.
Cornus Amonum Mill.
* *Azalea nudiflora* L.
Kalmia latifolia L.
Leucothoë Catesbei (Walt.) Gray.
Vaccinium arboreum Marsh.
Symplocos tinctoria (L.) L'Her.
Mohrodendron Carolinum (L.) Britton.
Styrax Americana Lam.
Fraxinus Americana L.
Chionanthus Virginica L.
Ipomoea lacunosa L.
* *Bignonia capreolata* L.
Catalpa bignonioides Walt.
Cephalanthus occidentalis L.
Lonicera sempervirens L.
Actinomeris alternifolia (L.) DC.

I have found the *Arundinaria* in fruit but once, on May 4, 1897, at Tallasee Shoals on the Middle Oconee River.

In the wet woods, which have some species in common with the river banks on one hand and the rich woods on the other, I have collected the following plants of interest:

Botrychium obliquum Muhl.
Woodwardia areolata (L.) Moore.
Asplenium Filix-foemina (L.) Bernh.
Onoclea sensibilis L.
Osmunda regalis L.
  cinnamomea L.
* *Selaginella apus* (L.) Spring.
Carex intumescens Rudge.
  crinita Lam.
  tenuis Rudge.
  leptalea Wahl.
  sterilis Willd.
* *Peltandra Virginica* (L.) Kunth.
Arisaema triphyllum (L.) Torr.
Adicea pumila (L.) Raf.
Boehmeria cylindrica (L.) Willd.
Habenaria flava (L.) Gray.
* *Alnus rugosa* (DuRoi) Koch.
* *Liriodendron Tulipifera* L.
* *Xanthorrhiza apiifolia* L'Her.
* *Ranunculus recurvatus* Poir.
Trautvetteria Carolinensis (Walt.) Vail.
Lindera Benzoin (L.) Blume.
Penthorum sedoides L.
Tiarella cordifolia L.
Parnassia asarifolia Vent.
Decumaria Barbara L.
Itea Virginica L.
* *Acer rubrum* L.
Falcata comosa (L.) Kuntze.
Phyllanthus Carolinensis Walt.
Impatiens biflora Walt.
Viola obliqua Hall.
  primulaefolia L.
Oxypolis rigidus (L.) Britton.
* *Azalea nudiflora* L.
Xolisma ligustrina (L.) Britton.
Steironema ciliatum (L.) Baudo.
Gentiana Elliottii Chapm.
Chelone glabra L.
**Mitchella repens* L.
Sambucus Canadensis L.
Mikania scandens (L.) Willd.
Pluchea petiolata Cass.

Of greatest interest perhaps are those species which inhabit the rich shady primeval forests on the north sides of hills. Among these may be mentioned the following:

Botrychium Virginianum (L.) Sw.
Adiantum pedatum L.
Asplenium platyneuron (L.) Oakes.
Polystichum acrostichoides (Mx.) Schott.
Poa brevifolia Muhl.
Carex laxiflora Lam.
Tradescantia montana Shuttl.
Juncoides campestre (L.) Kuntze.
  pilosum (L.) Kuntze.
Chamaelirium luteum (L.) Gray.
Uvularia perfoliata L.
  puberula Mx.
Vagnera racemosa (L.) Morong.
Polygonatum biflorum (Walt.) Ell.
Medeola Virginiana L.
Trillium stylosum Nutt.
Smilax ecirrhata (Engelm.) Wats.
Dioscorea villosa L.
Tipularia unifolia (Muhl.) B. S. P.
Corylus rostrata Ait.

Castanea dentata (Marsh.) Borkh.
Quercus rubra L.
Pyrularia pubera Mx.
Silene stellata (L.) Ait. f.
Alsine pubera (Mx.) Britton.
**Liriodendron Tulipifera* L.
Cimicifuga racemosa (L.) Nutt.
**Xanthorrhiza apiifolia* L'Her.
Anemone quinquefolia L.
Hepatica triloba Chaix.
Syndesmon thalictroides (L.) Hoffmg.
Sanguinaria Canadensis L.
Dentaria laciniata Muhl.
Heuchera Americana L.
Hydrangea arborescens L.
**Hamamelis Virginiana* L.
Waldsteinia parviflora Small.
Geranium maculatum L.
Acer leucoderme Small.
Rhamnus Caroliniana Walt.
Viola palmata L.
  **obliqua* Hill.
  hastata Mx.
  tripartita Ell.
Panax quinquefolium L.
Oxydendrum arboreum (L.) DC.
Pedicularis Canadensis L.
Thalesia uniflora (L.) Britton.
**Mitchella repens* L.
Viburnum acerifolium L.
Eupatorium aromaticum L.
Solidago caesia L.
Nabalus altissimus (L.) Hook.

Several of the above species reach the southern limit of their ranges in this region. *Juncoides pilosum*, *Corylus rostrata*, *Pyrularia pubera*, *Silene stellata*, *Anemone quinquefolia*, *Hydrangea arborescens*, *Viola hastata*, and *Solidago caesia* have been collected by Dr. J. K. Small in the vicinity of Stone Mountain, a few miles farther south but at a higher altitude than my stations for the same species. A few others extend down along the foothills to about the same altitude in eastern Alabama. Some of those which seem to have never been collected farther south than I have found them will be mentioned more in detail at the end of this paper.

In the drier and more open woods, including those on the south sides of hills and the second-growth oak woods which are frequent on the broad summits of the ridges, the flora is quite different from that of the rich shady original woods, although it is in some places difficult to draw a sharp line between them, and a few species are common to both. The following are some of the characteristic species of dry woods:

Panicum commutatum Schult.
Stipa avenacea L.
Melica mutica Walt.
Uniola latifolia Mx.
Danthonia sericea Nutt.
Carex Pennsylvanica Lam.
Tradescantia reflexa Raf.
Juncus tenuis Willd.
**Smilax rotundifolia* L.
  herbacea L.

Hypoxis erecta L.
Sisyrinchium Carolinianum Bicknell.
Juglans nigra L.
Hicoria alba (L.) Britton (*Carya tomentosa* Nutt.).
  glabra (Mill.) Britton (*C. porcina* Nutt.).
Castanea pumila (L.) Mill.
Quercus digitata (Marsh.) Sudw.
  coccinea Wang.
  Marylandica Muench.
  alba L.
  minor (Marsh.) Sargent.
  Prinus L.
Silene Virginica L.
Asimina parviflora (Mx.) Dunal.
**Anemone Virginiana* L.
Ranunculus fascicularis Muhl.
Crataegus spathulata Mx.
  Boyntoni Beadle.
Prunus serotina Ehrh.
  umbellata Ell.
Cercis Canadensis L.
Baptisia bracteata Ell.
**Trifolium reflexum* L.
Psoralea pedunculata (Mill.) Vail.
Stylosanthes riparia Kearney.
Lespedeza hirta (L.) Ell.
Vicia Hugeri Small.
Linum Virginianum L.
Jatropha stimulosa Mx.
Rhus glabra L.
Euonymus Americanus L.
Aesculus octandra Marsh.
Ceanothus Americanus L.
Vitis aestivalis Mx.
  cordifolia Mx.
  rotundifolia Mx.
Parthenocissus quinquefolia (L.) Planch.
Viola pedata L.
  villosa Walt.
  multicaulis (T. & G.) Britton.
Ligusticum Canadense (L.) Britton.
Sanicula Canadensis L.
  Marylandica L.
Zizia cordata (Walt.) DC.
Cornus florida L.
Chimaphila maculata (L.) Pursh.
Vaccinium stamineum L.
  corymbosum L.
Gelsemium sempervirens (L.) Ait. f.
Gentiana villosa L.
Amsonia Tabernaemontana Walt.
Asclepias variegata L.
Vincetoxicum hirsutum (Mx.) Britton.
Convolvulus repens L.
Phlox amoena Sims.
Onosmodium Virginianum (L.) A. DC.
Hedeoma pulegioides (L.) Pers.
Calamintha Caroliniana Sweet.
Salvia urticaefolia L.
Blephilia ciliata (L.) Raf.
Scutellaria integrifolia L.
  pilosa Mx.
Trichostema dichotomum L.
  lineare Nutt.
Dasystoma Virginica (L.) Britton.
Gerardia tenuifolia Vahl.
**Bignonia capreolata* L.
Ruellia ciliosa Pursh.
  strepens L.
Houstonia purpurea L.
Viburnum rufotomentosum Small.
Elephantopus Carolinianus Willd.
Solidago brachyphylla Chapm.
  petiolaris Ait.
  erecta Pursh.
Sericocarpus asteroides (L.) B.S.P.
Aster patens Ait.
Erigeron pulchellus Mx.
  annuus (L.) Pers.
Antennaria plantaginea (L.) R. Br.

Chrysogonum Virginianum L.
Heliopsis helianthoides (L.) B.S.P.
Verbesina Virginica L.
occidentalis (L.) Walt.
Coreopsis major Walt.
Mesadenia atriplicifolia (L.) Raf.
Carduus altissimus L.
Hieracium venosum L.

Another interesting area in middle Georgia may be called the dry fields, or the unforested portions of what are known as the gray gravelly and sandy lands (the latter designation including also those dry woods which have a soil of similar character). The soil of these dry fields consists mostly of gneissoid granite in all stages of disintegration, from large fragments to fine sand and clay. The flora of these fields, while somewhat poor in individuals, is quite rich in species, as may be seen from the following list:

Andropogon scoparius Mx.
Commelina Virginica L.
Tradescantia hirsuticaulis Small.
* *Yucca filamentosa* L.
Smilax glauca Walt.
Silene antirrhina L.
* *Anemone Virginiana* L.
Delphinium Carolinianum Walt.
Cebatha Carolina (L.) Britton.
Sassafras officinale Nees & Eberm.
Crataegus uniflora Muench.
Rubus trivialis Mx.
Fragaria Virginiana Duchesne.
Potentilla Canadensis L.
Prunus angustifolia Marsh.
Morongia angustata (T. & G.) Britton.
Crotalaria rotundifolia (Walt.) Poir.
* *Trifolium reflexum* L.
Cracca spicata (Walt.) Kuntze.
Virginiana L.
Clitoria Mariana L.
Rhynchosia tomentosa (L.)H.& A.
Oxalis recurva Ell.
Acalypha Virginica L.
Tragia urticaefolia Mx.
Euphorbia corollata L.
Rhus copallina L.
Hypericum maculatum Walt.
Passiflora incarnata L.
Kneiffia fruticosa (L.) Raimann.
Daucus pusillus Mx.
Diospyros Virginiana L.
Apocynum cannabinum L.
Asclepias tuberosa L.
obtusifolia Mx.
Acerates viridiflora (Raf.) Eaton.
Ipomoea pandurata (L.) Meyer.
Gilia rubra (L.) Heller.
Phacelia hirsuta Nutt.
Verbena Canadensis (L.) Britton.
Salvia lyrata L.
Scutellaria multiglandulosa (Kearney) Small.
Physalis heterophylla nyctaginea Rydb.
Virginiana Mill.
Linaria Canadensis (L.) Dumont.
Pentstemon hirsutus (L.) Willd.
Plantago Virginica L.
Houstonia longifolia Gaertn.
Eupatorium compositifolium Walt.
Kuhnia eupatorioides L.
Aster ericoides L.
Gnaphalium obtusifolium L.

Silphium Asteriscus L.
Coreopsis grandiflora Hogg.
Senecio Smallii Britton.
Adopogon Carolinianum (Walt.) Britton.

Many of the above species are more common southward and westward, and do not range much farther northeast than Athens.

At many points in the gray gravelly and sandy lands the underlying rock is hard enough to resist disintegration and becomes exposed on the surface. On these granite outcrops, and particularly around their edges, where there is apt to be more or less moisture, are found some rather interesting plants, among them being the following:

Cheilanthes lanosa (Mx.) Watt.
Woodsia obtusa (Spreng.) Torr.
Fimbristylis autumnalis (L.) R. & S.
Carex cephalophora Muhl.
Juncus marginatus Rostk.
Nothoscordum bivalve (L.) Britton.
Agave Virginica L.
Talinum teretifolium Pursh.
Cerastium brachypodum (Engelm.) Robinson.
Arenaria brevifolia Nutt.
Arabis Virginica (L.) Trel.
Diamorpha pusilla Nutt.
Saxifraga Virginiensis Mx.
Trifolium Carolinianum Mx.
Oxalis violacea L.
Crotonopsis linearis Mx.
Sarothra gentianoides L.
**Opuntia vulgaris* Mill.
Myosotis verna Nutt.
**Ilysanthes refracta* (Ell.) Benth.
Plantago elongata Pursh.
Valerianella radiata (L.) Dufr.

Still another peculiar flora is found in deposits of dry sand along the rivers at a few points. The species frequenting this sand are quite few, on account of the very small relative extent of these deposits. I have noticed the following psammophilous species along the two rivers in Clarke Co.:

Pteris aquilina L.
**Yucca filamentosa* L.
Lupinus perennis L.
Ascyrum hypericoides L.
**Opuntia vulgaris* Mill.
**Vaccinium arboreum* Marsh.
Breweria humistrata (Walt.) Gray.
Monarda punctata L.
Chrysopsis graminifolia (Mx.) Nutt.

I have found all of these, with the exception of *Lupinus*, much more abundant in south Georgia, where the soil is nearly all sand.

Lastly may be considered the plants of fields, roadsides and pastures, including the native and introduced weeds. The following is a partial list of such species:

Rumex crispus L.
    obtusifolius L.
    Acetosella L.
Polygonum Convolvulus L.
Amarantus spinosus L.
    retroflexus L.
Phytolacca decandra L.
Boerhaavia erecta L.
Mollugo verticillata L.
Portulaca oleracea L.
Agrostemma Githago L.
Alsine media L.
Cerastium viscosum L.
Anychia dichotoma Mx.
Ranunculus parviflorus L.
    abortivus L.
Lepidium Virginicum L.
Coronopus didymus (L.) J. E. Smith.
Sisymbrium officinale (L.) Scop.
Cardamine hirsuta L.
Capsella Bursa-pastoris (L.) Medic.
Draba verna L.
Stenophragma Thaliana (L.) Celak.
Rubus nigrobaccus Bailey.
Duchesnea Indica (Andr.) Focke.
Alchemilla arvensis (L.) Scop.
Rosa rubiginosa L.
    bracteata Wendl.
Medicago Arabica (L.) All.
Melilotus alba Lam.
Trifolium procumbens L.
Trifolium arvense L.
    pratense L.
    repens L.
Vicia hirsuta (L.) Koch.
    sativa L.
Geranium Carolinianum L.
Oxalis stricta L.
Melia Azederach L.
Acalypha ostryaefolia Riddell.
Euphorbia maculata L.
    Preslii Guss.
Modiola Caroliniana (L.) Don.
Oenothera laciniata Hill.
Hartmannia speciosa (Nutt.) Small.
Daucus Carota L.
Chaerophyllum Teinturieri Hook.
Anagallis arvensis L.
Heliotropium Indicum L.
Lithospermum arvense L.
Verbena bracteosa Mx.
Lamium amplexicaule L.
Solanum nigrum L.
    Carolinense L.
Datura Tatula L.
Verbascum Thapsus L.
    Blattaria L.
Veronica peregrina L.
    arvensis L.
Plantago major L.
    lanceolata L.
    aristata Mx.
    heterophylla Nutt.
Houstonia coerulea L.
Legouzia perfoliata (L.) Britton.
Solidago Canadensis L.
Erigeron Canadensis L.
Filago nivea Small.
Ambrosia artemisiaefolia L.
    trifida L.
Xanthium strumarium L.
Bidens frondosa L.
    bipinnata L.
Helenium tenuifolium Nutt.
Achillea Millefolium L.
Anthemis Cotula L.
Chrysanthemum Leucanthemum L.
Arctium Lappa L.
Carduus lanceolatus L.
Taraxacum officinale Weber.

I have not attempted to make all the above lists complete, and have purposely omitted from them several species which are rare or not characteristic of any of these areas. As my observations in this region have not extended over the summer months, I have doubtless omitted many species which are characteristic of the several areas, especially in the first group, that of hydrophytic plants.

In this connection it might be of interest to note what plants do not occur in middle Georgia. The genera *Lycopodium* and *Polygala*, for instance, which are represented by several species both in south Georgia and in the Northern States, seem to be wanting in middle Georgia. Some species of these two genera inhabit the northern forests, while others are found mostly near the coast, and the northern species do not seem to extend quite so far south, or the coast species so far inland, as middle Georgia. Also the genera *Xyris*, *Eriocaulon*, *Lilium*, *Iris*, *Limodorum*, *Castalia*, *Sarracenia*, *Drosera*, *Triadenum*, *Proserpinaca*, *Myriophyllum*, *Bartonia*, *Limnanthemum* and *Utricularia*, which are represented north and south, seem to be rare or absent in middle Georgia. The same might be said also of many species of several other genera, such as *Rhynchospora*, *Ludwigia* and *Sabbatia*. The Orchidaceae, Hypericaceae and Asclepiadaceae are represented by fewer species in middle Georgia than in other parts of the country.

Below I append an annotated list of some of the more rare or noteworthy species of this region which have come under my observation. As no topographical map of the region of my explorations in middle Georgia has yet been made, the altitudes given below are only approximate, but it is believed that none of them are more than 50 feet in error.

POLYPODIUM VULGARE L. Sp. Pl. 1085. 1753

There is a station for this species on the south side of Bobbin Mill Creek, Clarke Co., where it grows on the brow of a high granite cliff and some adjacent smaller rocks, in company with its congener, *P. polypodioides*. The altitude is about 620 ft. This is probably the southern limit of *P. vulgare* in eastern North America.

POA BREVIFOLIA Muhl. Gram. 138. 1817

In rich woods along Bobbin Mill Creek, flowering in March.

Altitude 610 feet. This species does not seem to have been reported from as far south as Georgia before.

Scirpus Georgianus sp. nov. (Plate 22)

Culm erect, about 5 dm. tall, terete or nearly so, 3–4-leaved. Leaves smooth, the lower ones about 2 dm. longand 1 cm. wide; sheaths green; involucral leaves about 3, the longest exceeding the umbel; umbel thrice compound, many-rayed, the longest rays about 1 dm. long, rather stiff and ascending, the shorter and secondary rays most spreading at right angles; spikelets green, about 3 mm. long, 10–15-flowered, in glomerules of 5–10; scales orbicular-ovate, about 1.5 mm. long, with somewhat loosely-spreading awns; margins thin and membranous, colorless or slightly tinged with brown; midrib green, with a narrow whitish keel, prolonged into an awn about half as long as the body of the scale with 3 or 4 short scarious teeth at its apex, giving the whole spikelet a characteristic striate and bristly appearance: stamens 3: style 3-cleft: achene oblong, about 0.8 mm. long, short-beaked, compressed-triangular: bristles none.

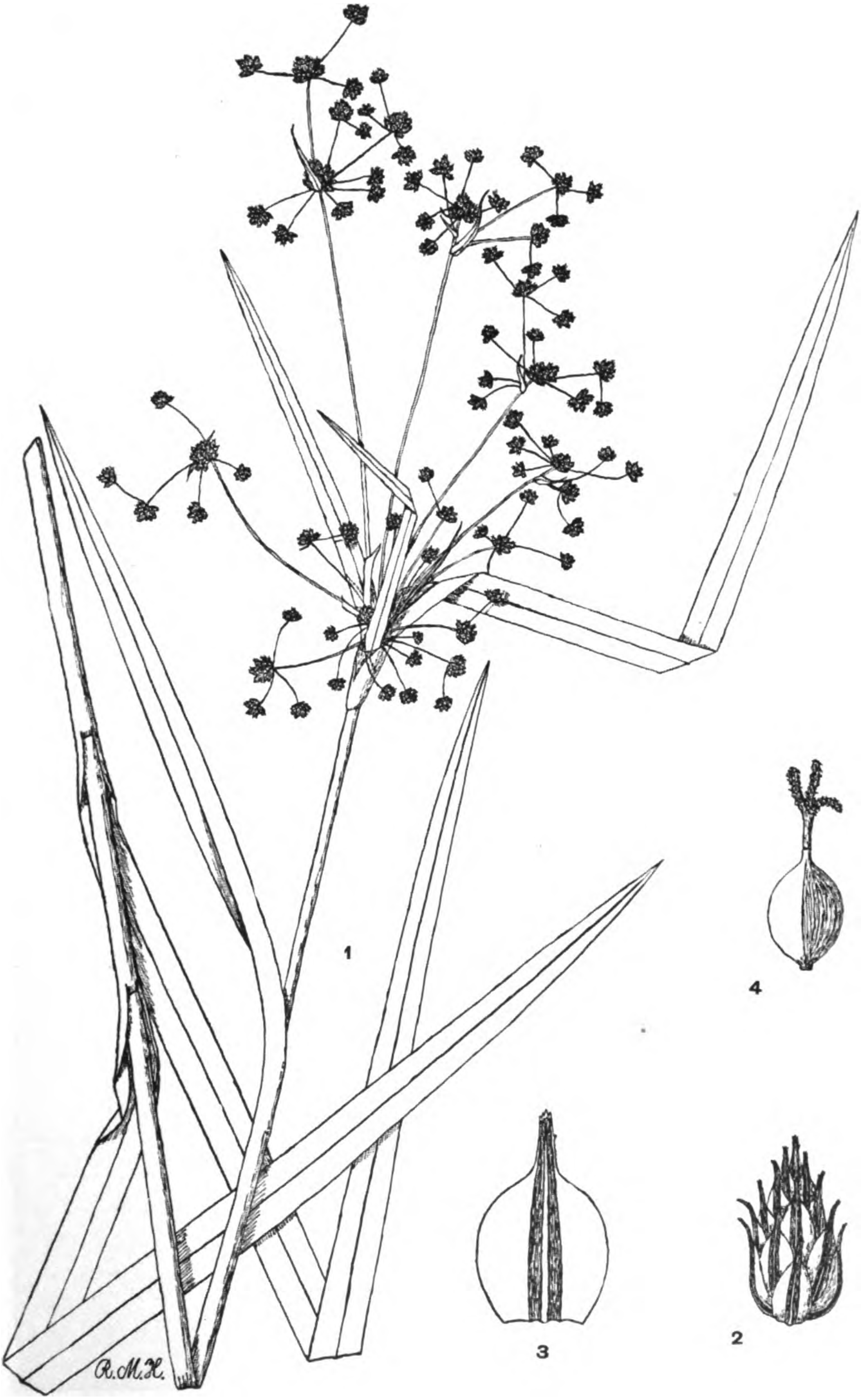
A unique species, allied to *S. atrovirens* and *S. polyphyllus* (neither of which is known in middle Georgia), but differing from both in its greener spikes, peculiar scales, and absence of bristles. Another distinguishing character is found in the sheaths of the leaves. In the two related species an elongated triangular portion of the summit of the sheath opposite the insertion of the leaf is thin and membranous, while in *S. Georgianus* this portion is represented by only a narrow horizontal brownish band, as shown in the accompanying plate.

Scirpus Georgianus is further distinguished from *S. atrovirens* by its more numerous glomerules of fewer spikelets, and from *S. polyphyllus* by its fever and broader leaves.

Collected in muddy alluvial soil on the bank of the Middle Oconee River, Clarke Co., May 23, 1897. Accompanied by *Ranunculus recurvatus* and *Thalictrum polygamum*. One specimen has been placed in the herbarium of the New York Botanical Garden.

Explanation of Plate 22

1. Portion of plant, × ⅔.
2. Single spikelet, × 10.
3. A scale, × 20.
4. Achene and style, × 20.



SCIRPUS GEORGIANUS

Of the genus *Tradescantia*, as revised by Dr. J. K. Small,* I have collected the three following species in Clarke Co.:

T. REFLEXA Raf. New Fl. N. A. **2**: 87. 1836

In dry woods, Athens, flowering in May. This seems to be one of its easternmost known stations.

T. HIRSUTICAULIS Small, *l. c.*, 233

Dr. Small cites three stations for this species, and I can now add a fourth and northernmost, viz: Athens, where I collected it in dry fields near the Oconee River in 1895, 1896 and 1897. It flowers there in April. About half of the specimens observed have pink-purple petals, while the rest have bright blue ones like most other species of the genus. There seem to be none with intermediate colors, and the two forms make a pleasing contrast when growing side by side.

T. MONTANA Shuttl.; Britton, Ill. Fl. **1**: 377. 1896

In rich woods, Athens, flowering in May. Altitude about 650 ft. This station is farther south and at a lower altitude than any previously known.

JUNCOIDES PILOSUM (L.) Kuntze, Rev. Gen. Pl. 725. 1891

In rich shady woods, Athens; with *J. campestre*, and flowering at the same time (March and April). Altitude about 650 ft.

UVULARIA SESSILIFOLIA L. Sp. Pl. 305. 1753

Alluvial soil on banks of Middle Oconee River, between Tallasee Shoals and Princeton. Altitudes 600–650 ft. This is near its southern limit.

UVULARIA PUBERULA Mx. Fl. Bor. Am. **1**: 199. 1803

In rich woods in Athens and near Bobbin Mill Creek, altitudes 610–650 ft. This species has not been reported from so far south by recent authors, but Elliott (Bot. S. C. & Ga. **1**: 391) describes a *Uvularia* "from specimens sent * * * from Athens, by Mr. Green," and asks "Do they belong to this species?" His uncertainty is probably due to immature material. The description applies very well to the flowering state of *U. puberula*, and as I have collected this species in fruit also, with leaves fully expanded, probably in the identical locality from which Mr. Green secured his specimens, there can no longer be any doubt as to the identity of Elliott's plant.

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* Bull. Torr. Club, **24**: 228–236, May 29, 1897.

SISYRINCHIUM CAROLINIANUM Bicknell, Bull. Torr. Club, **26**: 221. My. 1899

Common in dry soil, Clarke Co. My specimens, collected near the Middle Oconee River, April, 1897, have been identified by Mr. Bicknell.

CYPRIPEDIUM PARVIFLORUM Sal. Trans. Linn. Soc. **1**: 77. 1791

Collected in dry woods near Middle Oconee River at Tallasee Shoals, May 4–7, 1897. Altitude about 725 feet. This seems to be about 100 miles farther south than any previously known station for this species.

TIPULARIA UNIFLORA (Muhl.) B.S.P. Prel. Cat. N. Y. 51. 1888

I have found the evergreen winter leaves and dead flowering stems of this rare and curious orchid in rich woods at four or five stations in Athens.

CASTANEA DENTATA (Marsh) Borkh. Handb. Forstb. **1**: 741. 1800

In rich woods, Athens, altitude 650 ft. Trees rather few and small, and fruiting sparingly. Is the southern limit of this species moving northward? Bartram (Travels, p. 36) mentions "*Fagus castanea*" as one of the trees observed in the vicinity of Wrightsborough, Ga. (now in McDuffie Co.), in 1773, and Chapman (Fl. S. States, ed. 1, 424. 1860) gives its range as "West Florida and northward" (perhaps an error), but it is now generally supposed to be confined to the mountains and northern states.

PYRULARIA PUBERA Mx. Fl. Bor. Am. **2**: 233. 1803

About 15 or 20 individuals in an area of a few square rods in rich shady woods, Athens. Altitude 650 ft. This is near the southern limit of this species. It flowers in April, but formed no fruit in the two seasons in which I observed it, and seems likely to become extinct in this locality. The flowers although apparently perfect all fall off a few days after expanding.

CHENOPODIUM BOSCIANUM Moq. Enum. Chenop. 21. 1840

In October, 1896, I collected this plant in dry open woods on the University campus in Athens. It does not seem to have been reported from Georgia before.

BOERHAAVIA ERECTA L. Sp. Pl. 3. 1753

In cultivated ground on the University campus, Athens, in flower October, 1896. This is one of its northernmost stations.

ALSINE PUBERA (Mx.) Britton, Mem. Torr. Club, **4**: 107. 1893

Rich shady woods, Athens. Altitude about 650 ft. Flowering from March to May. Southern limit?

CERASTIUM BRACHYPODUM (Engelm.) Robinson; Britton, Mem. Torr. Club, **5**: 150. 1894

Collected on dry rocks near Oconee River, Athens, March 15, 1897, with *Myosotis verna* and *Valerianella radiata.* New to the southeastern states.

CIMICIFUGA RACEMOSA (L.) Nutt. Gen. **2**: 15. 1818

Found in May, 1897, with flowers unopened, in rich woods on the southwest side of the Middle Oconee River at Tallasee Shoals and Princeton. Southern limit.

ARABIS CANADENSIS L. Sp. Pl. 665. 1753

In dry rocky woods near Oconee River, Athens, and Jack's Creek, Morgan Co. The latter station seems to be the southernmost known.

DIAMORPHA PUSILLA Nutt. Gen. **1**: 293. 1818

On flat exposed granite rock, Athens, with *Arenaria brevifolia.* This little plant seems to have a very brief period of activity. On April 20, 1897, the plants were in full bloom, covering the rock with a mass of red stems and leaves and pinkish flowers; but when the locality was visited on May 15th all the leaves and petals had fallen, and the now fruiting plants were dried up and scarcely visible.

HEUCHERA RUGELII Shuttl.; Kunze, Linnaea, **20**: 43. 1847

A few specimens of this plant grow in crevices on the north face of the granite cliff mentioned above as the habitat of *Polypodium vulgare.* I have found it in flower from September to November in 1896. This seems to be its southermost known station, and the first in Georgia.

PARNASSIA ASARIFOLIA Vent. Jard. Malm. *pl. 39.* 1803

In wet woods, at one locality in Athens. Altitude 625 ft. Previously known only from the higher mountains. In October, 1896, when I collected my specimens, the plant began to flower about the middle of the month, which is about six weeks later than it does in North Carolina, according to specimens from that state.

CRATAEGUS BOYNTONI Beadle, Bot. Gaz. **28**: 409. Jan. 10, 1900

In dry woods, Clarke Co., where it is one of the commonest species of the genus. My specimens, which were collected in Athens, April, 1897, have been determined by Dr. Britton.

WALDSTEINIA PARVIFLORA Small, Bull. Torr. Club, **25**: 137. 1898

In rich woods near Tanyard Branch and Bobbin Mill Creek, Clarke Co. Altitude about 600 ft. Flowering March–May. These stations are farther south and at a lower altitude than any cited by Dr. Small in his description.

ALCHEMILLA ARVENSIS (L.) Scop. Fl. Carn, ed. 2, **1**: 115. 1770

In April, 1897, I found a small patch of this diminutive weed in a pasture in Athens, which makes the first known station for it in Georgia, and the southermost in this country.

ROSA BRACTEATA Wendl. Bot. Beobacht. 50. 1798

Common along fences and roadsides in Athens, flowering from June to October.

MEDICAGO ARABICA (L.) All. Fl. Ped. **1**: 315. 1785

In fields and along roadsides, Clarke Co. This species does not seem to have been reported as naturalized in the southeastern states before.

ROBINIA PSEUDACACIA L. Sp. Pl. 722. 1753

Collected in rich woods near the Middle Oconee River in Jackson Co., May 6, 1897, in flower. Altitude 700 ft. My specimens, which I refer with some hesitation to this species, were slender shrubs about 2 m. tall, with odorless flowers.

STYLOSANTHES RIPARIA Kearney, Bull. Torr. Club, **24**: 565. Dec., 1897

In dry woods, Athens. My specimens were collected on the University campus, at an altitude of about 725 ft., May 27, 1897.

VICIA HUGERI Small, Bull. Torr. Club, **24**: 490. Nov., 1897

In dry, woods, Clarke Co. I first collected the plant in Athens in April, 1895. This is farther east than any station cited by Dr. Small.

OXALIS RECURVA Ell. Bot. S. C. & Ga. **1**: 526. 1821; Small, Bull. Torr. Club, **21**: 471–474. *pl. 422.* 1894

I can add another to the increasing list of stations for this long misunderstood species, viz: Athens, where I collected it in a dry field near the Oconee River, April 24, 1897. My specimens have been identified by Dr. Small.

CROTON CAPITATUS Mx. Fl. Bor. Am. **2**: 214. 1803

Collected in a railroad cut, Athens, Sept. 20 and Oct. 31, 1896. This seems to be one of the easternmost points reached by this woolly western plant in its travels.

ACER LEUCODERME Small, Bull. Torr. Club, **22**: 367. 1895

Common in rich shady woods, on the north side of hills, in Clarke Co., flowering in April. Identified by Dr. Small.

VIOLA CUCULLATA Ait. Hort. Kew. **3**: 288. 1789. Britton & Brown, Ill. Fl. **3**: 520. *f. 2487b.* 1898

The true *V. cucullata* as now understood, is represented from the southern states in the Columbia University Herbarium by a single specimen from Knoxville, Tenn., and I can find no record of its having been collected farther south. I collected it, however, in a small bog in Athens at an altitude of about 625 ft. in 1896 and 1897, and I also observed what appeared to be the same thing in a springy place near Tallasee Shoals on the Middle Oconee River, at an altitude of 650 ft., May 5, 1897. It begins to flower about the first of April.

VIOLA MULTICAULIS (T. & G.) Britton, Mem. Torr. Club, **5**: *227.* 1894

In dry woods, on the north side of the valley of Sandy

Creek, Clarke Co. Altitude about 625 ft. This is one of the easternmost stations for this species, and seems to be also the northernmost known, with the exception of the type locality in Kentucky.

VIOLA HASTATA Mx. Fl. Bor. Am. **2**: 149. 1803

Until within a few years Athens was the only known station in Georgia for this rare species. I have found it in one locality in the city, in low rich woods, at an altitude of about 600 feet, which is probably the lowest altitude at which it has been collected. I secured two flowering specimens in March and April, 1897, at which time there were perhaps a dozen individuals in all.

VIOLA TRIPARTITA Ell. Bot. S. C. & Ga. **1**: 302. 1817; Small, Bull. Torr. Club, **24**: 497, Nov., 1897

V. hastata var. *tripartita* Gray, Bot. Gaz. **11**: 291. 1886.

Elliott (*l. c.*) describes this species, as also the preceding, "from specimens collected near Athens, Georgia, by Mr. Green." I have found it quite abundant in rich woods in several parts of the city. This species was long considered a variety or "aberrant form" of *V. hastata*, but it could never have been so considered by any one who was familiar with the two species in the field; and Dr. Small has recently pointed out some of the many differences between them. I had opportunity to compare the two species in the living state in the spring of 1897, and was impressed with their total dissimilarity. There is, however, a form which in the herbarium appears on superficial examination to be somewhat intermediate between the two, but its affinities are clearly with *tripartita*. This form is **Viola tripartita glaberrima** (*V. hastata* var. *glaberrima* Ging.; DC. Prodr. **1**: 300. 1824; Chapm. Fl. S. States, ed. 3, 34. 1897). It differs from typical *tripartita* in having leaves all undivided and glabrous, but is in other respects very similar. It seems to extend farther south than the type, and is the plant which was taken for *V. hastata* in Florida. I have collected it in rich woods near the Middle Oconee river, about two miles southeast of Athens, in 1896 and 1897. Like *V. tripartita*, with which it is perhaps connected by intermediate forms, its leaves are conspicuously plicate, a character which distinguishes it at once from *V. hastata* in the field, but is not evident in herbarium specimens.

ELAEAGNUS HORTENSIS Bieb. Fl. Taur. Cauc. 1: 112. 1808

Common in dry woods in the southern part of Athens, appearing perfectly at home. Flowering in April. This plant has evidently been long established, and I have been unable to trace its origin. It does not seem to be cultivated in the vicinity at the present time.

HARTMANNIA SPECIOSA (Nutt.) Small, Bull. Torr. Club, **23**: 181. 1896

In May, 1896, I found a colony of this western species flourishing and blossoming by the roadside between Florence and Bostwick, Morgan Co., and in other similar localities a little later. It does not seem to have been reported from middle Georgia before.

PANAX QUINQUEFOLIUM L. Sp. Pl. 1050. 1753

A few plants in rich shady woods near Bobbin Mill Creek, Clarke Co. Altitude 610 feet. This seems to be the southernmost known station for this species in North America.

SCANDIX PECTEN-VENERIS L. Sp. Pl. 256. 1753

One specimen found on the University campus, Athens, with nearly mature fruit, April 25, 1896. The locality was obliterated the following winter, and I did not see the plant again.

DAUCUS PUSILLUS Mx. Fl. Bor. Am. 1: 164. 1803

In dry fields, Athens, at altitudes from 600–700 feet. This is one of the northernmost stations known for this species.

LEUCOTHOË CATESBAEI (Walt.) Gray, Man. ed. 2, 252. 1856

On shaded banks of both rivers, Clarke Co. Altitudes 580–675 ft. This is probably near the southern limit of this Alleghanian species.

GALAX APHYLLA L. Sp. Pl. 200. 1753

In rocky woods on both banks of the Middle Oconee River, Clarke Co., rare. Altitudes 600–675 ft. In flower May 28, 1897. This is its southern limit, so far as known.

LYSIMACHIA NUMMULARIA L. Sp. Pl. 148. 1753

This species does not seem to have been reported from the Southern States. It is very abundant in open meadows along

Tanyard Branch in Athens, but rarely flowers. I found only two flowering specimens in 1896 and three in 1897. Though it is not a native, I have never seen it in cultivation in Georgia, and cannot satisfactorily account for its occurrence in Athens.

MOHRODENDRON CAROLINUM (L.) Britton, Gard. & For. **6**: 463. 1893

I have noticed one peculiarity of this species which does not seem to have ever been recorded. Its corollas are open wide some weeks before anthesis, while still green and not half grown. I suspect that the same may be true of the other species of the genus and of the related genus *Styrax*, but I have never had opportunity to observe the aestivation of the latter.

CUSCUTA COMPACTA Juss.; Choisy, Mem. Soc. Gen. **9**: 281. *pl. 4. f. 2.* 1841

On shrubs near Oconee River, Athens. This is one of the easternmost stations for this species, and seems to be the first reported in Georgia.

GILIA RUBRA (L.) Heller, Contr. Herb. F. & M. Coll. **1**: 81. 1895

In dry rocky field near Oconee River, Athens, altitude 600 ft. I can find no record of a more northern station for this species.

Scutellaria multiglandulosa (Kearney) Small

S. integrifolia multiglandulosa Kearney, Bull. Torr. Club, **21**: 482. 1894.

This seems to be the same plant which is described by Dr. Chapman in the first edition of his Southern Flora (1860) as *S. integrifolia* L. and in the third edition (1897) referred to *S. brevifolia* Gray, with a mark of doubt. A comparison of one of my specimens with type material of *S. brevifolia* from Texas (Hall's no. 458) shows the two to be clearly distinct, however. Collected in a dry field in Athens, near the river, in 1895, 1896 and 1897. Altitude 600 ft. Previously known only from south Georgia and Florida. This plant, which Dr. Small now separates as a distinct species, bears little resemblance to *S. integrifolia*, of which it was published as a variety. In all the specimens I have collected the corollas are invariably white, a character which has not been noted before. It flowers in Athens in May and June.

BLEPHILIA CILIATA (L.) Raf.; Benth. Lab. 319. 1833

In dry woods, Athens, flowering in May and June. This is near its southern limit.

THALESIA UNIFLORA (L.) Britton, Mem. Torr. Club, **5**: 298. 1894

In rich woods, Athens; rare. This species does not seem to have been recently reported from the Southern States, and I have seen no southeastern specimens besides my own.

PAULOWNIA TOMENTOSA (Thunb.) Baill. Hist. Pl. **9**: 434. 1888

This tree is becoming naturalized in Georgia. In Athens it has escaped to the woods in several places, and seems very much at home.

GALIUM UNIFLORUM Mx. Fl. Bor. Am. **1**: 179. 1803

Collected in dry woods on west bank of Middle Oconee River, opposite Princeton, May 28, 1897. Altitude 600 ft. This is its northernmost station, as far as I know.

VIBURNUM ACERIFOLIUM L. Sp. Pl. 268. 1753

In rich woods, Clarke and Morgan Cos. This species is not definitely known from farther south.

VIBURNUM RUFOTOMENTOSUM Small, Bull. Torr. Club, **23**: 410. 1896

In dry woods, Clarke Co.; not rare.

LONICERA JAPONICA Thunb. Fl. Jap. 89. 1784

Dr. Small has noted the naturalization of this species in the Southern States. It is quite common about Athens, growing along roadsides or often in moist woods and along streams, and thriving as well as any native plant. It flowers from May to November, and fruits freely.

CAMPANULA DIVARICATA Mx. Fl. Bor. Am. **1**: 109. 1803

On rocks near Bobbin Mill Creek, Clarke Co., flowering in September. Altitude 620 ft. This is another Alleghanian plant which extends well down into the foothills.

EUPATORIUM COMPOSITIFOLIUM Walt. Fl. Car. 199. 1788

E. coronopifolium Willd. Sp. Pl.

In dry fields, Athens, flowering late in October. This is one of its highest and northernmost stations known.

SOLIDAGO BRACHYPHYLLA Chapm.; T. & G. Fl. N. A. **2**: 218. 1841

In dry oak woods, Athens, altitude 675 ft. Probably its northern limit.

PLUCHEA PETIOLATA Cass. Dict. Sci. Nat. **42**: 2. 1826; Kearney, Bull. Torr. Club, **21**: 265. 1894

Mr. Kearney (l. c.) has pointed out the difference between this species and *P. camphorata* of the coast. It does not seem to have been reported from Georgia however. I found it in September, 1896, in wet woods in the southern part of Athens.

FILAGO NIVEA Small, Bull. Torr. Club, **24**: 333. July, 1897

Evax multicaulis DC. Prodr. **5**: 459. 1836.

Dr. Small has noted the occurrence of this western plant in the vicinity of Stone Mountain. In May, 1896, I found it in a field near Bostwick, in Morgan Co., and a year later in Athens, which is about 50 miles farther east than Stone Mountain.

COREOPSIS GRANDIFLORA Hogg; Sweet, Brit. Fl. Gard. **2**: *pl. 175.* 1825–7

In dry fields, Athens. This is its eastern limit, as far as known.

SENECIO SMALLII Britton, Mem. Torr. Club, **4**: 132. 1893

Common in dry fields, Clarke, Oconee and Walton Cos.

ACANTHOSPERMUM AUSTRALE (L.) Kuntze, Rev. Gen. Pl. 303. 1891

According to Dr. Chapman, who examined one of my specimens, this tropical weed was first introduced in wool at the Augusta factories. If so it has not spread northward as much as southward. In the fall of 1896 I collected it along one of the railroads in Athens, which seems to be the northernmost point it has reached.

COLUMBIA UNIVERSITY.

The Publications of the Department of Botany, Columbia University, consist of Memoirs in quarto and Contributions in octavo.

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 172

STUDIES IN SISYRINCHIUM—VIII: SISYRINCHIUM CALIFORNICUM AND RELATED SPECIES OF THE NEGLECTED GENUS HYDASTLYUS

BY EUGENE P. BICKNELL

NEW YORK
1900

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Studies in Sisyrinchium—VIII: Sisyrinchium Californicum and Related Species of the Neglected Genus Hydastylus

By Eugene P. Bicknell

The well-known *Sisyrinchium Californicum* of Aiton's Hortus Kewensis has rested for so long undisturbed in the genus *Sisyrinchium* that some fault of iconoclasm would seem to attend its removal from its time-honored place. Nevertheless the generic misfit of the plant in *Sisyrinchium* was long ago apprehended and a separate genus was created for it by Salisbury on the suggestion of Dryander (Trans. Hort. Soc. **1**: 310. 1812). This genus, *Hydastylus*, adequately founded as I do not doubt, appears to have missed the sanction of any later systematist.

The species was first brought to notice by Archibald Menzies who imported it into England for cultivation in 1796. Ten years later it was described and figured by Ker-Gawl as *Marica Californica* (Bot. Mag. *t. 983*, 180?), a disposition of the plant manifestly having regard for family relationship rather than generic affinity.

In 1812 Aiton, or Dryander, it may be, with clearer view transferred it to *Sisyrinchium*. The same year Dryander and Salisbury reached a truer conception of the plant's separateness of structure from *Sisyrinchium*, and their genus *Hydastylus* must now be revived to accommodate not this plant alone but also a well-defined generic group of yellow-flowered species of which it is the type.

The genus *Hydastylus* may be thus characterized:

Annual or perennial herbs with the habit and appearance of *Sisyrinchium*, but usually only imperfectly caespitose, discoloring or turning black in drying, most or all of the species staining purple under appropriate conditions; rootstocks usually obscure or poorly developed, the delicate roots pale and slender. Leaves narrowly linear, the conduplicate bases more or less membranously expanded: stems ancipital, simple and scapose, terminated by a spathe of two conduplicate bracts enclosing membranous scales; pedicels slender, often long-exserted, straight or finally recurved: perianth yellow, the mostly narrowed segments black-lineate or with brown or orange veins, obtuse or acute but not aristulate nor emarginate; filaments more or less adherent below but commonly free nearly to the base or at least for more than half their length, somewhat spreading above; anthers narrowly linear, versatile; style-branches slender, divergent: capsule oblong to globose or pyriform, more or less trigonous, three-celled, many- or few-seeded: seeds rounded, distinctly pitted, widely umbilicate or acetabuliform.

Western North American from Vancouver to Lower California and at least to southern Mexico, extending east to Arizona and Coahuila.

The most evident points of difference between this genus and *Sisyrinchium* reside in the flowers and consist of partially free filaments, linear versatile anthers and slender spreading style-branches, together with yellow perianth, the lineate segments never aristulate nor emarginate and strictly glabrous ovary. In addition there is some indefinable foliar attribute which with more or less clearness announces the genus quite apart from the flowers. In fact two of the species here described are confidently referred to the genus although the flowers are unknown.

It will doubtless be found to be in accordance with the alignment of nature to limit the genus *Sisyrinchium* by the characters of tubular-united filaments, short erect anthers, undivided style and, with rare exceptions, blue, violet or white flowers, with the perianth segments aristulate or acutely pointed; furthermore the ovary is puberulent in the majority of species.

This understanding of the genus will exclude from it a number of South American species which it has hitherto been held to embrace and make necessary the formation of still other genera, but this, I fully believe, will prove to be the only logical treatment of the group. There might have seemed little reason for this view under the long-established belief that the genus in North America was at best a most insignificant one but now that its numerical importance has disclosed itself the beautiful homogeneity of the species of the blue-flowered section becomes in itself very suggestive and bears strongly against the congeneric equivalent with their group of the heterogeneous assemblage of species that have been included within it.

On this view *Sisyrinchium* proper is primarily a North American genus which though well-represented in South America has there a much less extensive representation than has been accorded it.

Of the genus *Hydastylus* it should be said that it may require to be more broadly interpreted in order to accommodate certain branched and yellow-flowered South American species which have yet to be made a subject of critical study.

Key to the Species of Hydastylus

Flowers large; perianth 12–18 mm. long; leaves 2–7 mm. wide, mostly turning very dark when dry.
  Flowers large; pedicels mostly longer than the bracts, 20–40 mm. long; seeds 1.25–1.5 mm. in diameter. 1. *H. Californicus.*
  Flowers smaller; pedicels mostly shorter than the bracts, 10–20 mm. long; seeds .75–1 mm. in diameter. 3. *H. brachypus.*
Flowers small to medium sized, 6–12 mm. long; leaves mostly 1–3 mm. wide, not usually turning very dark; pedicels not recurved.
  Anthers small, 2–2.5 mm. long.
    Pedicels little longer than the bracts, erect; perianth 8–10 mm. long. 2. *H. borealis.*
    Pedicels slenderly exserted, somewhat spreading; perianth 6–8 mm. long. 5. *H. rivularis.*
  Anthers larger, 3–5 mm. long.
    Pedicels more or less exserted, erect; perianth 8–12 mm. long. 4. *H. Elmeri.*
    Pedicels long-exserted, closely erect; plant slender, 15–30 cm. high; perianth 8–12 mm. long. 6. *H. longipes.*
    Pedicels long-exserted, somewhat spreading; plant low or depressed; leaves 1.5–2 mm. wide. 7. *H. parvus.*
    Pedicels exserted; plant low or depressed; leaves .05–1.5 mm. wide. 8. *H. Schaffneri.*
Flowers very small, 3–5 mm. long; pedicels recurved-spreading; capsules 3–6 mm. long.
  Outer bract much prolonged; anthers 1 mm. long. 9. *H. cernuus.*
  Bracts subequal; anthers 3–5 mm. long. 10. *H. subcernuus.*
Flowers unknown; leaves very thin; capsules 6–10 mm. long.
  Capsules large, 8–10 mm. long, pyriform; leaves and stem 2–5 mm. wide, serrulate; pedicels flexuous. 11. *H. serrulatus.*
  Capsules 6–7 mm. long, obovoid-oblong; leaves and stem narrower, not serrulate; pedicels spreading or recurved. 12. *H. translucens.*

HYDASTYLUS CALIFORNICUS (Ker.) Salisb. Trans. Hort. Soc. 1: 310 1812.

Marica Californica Ker-Gawl. Bot. Mag. *t. 983*. 1806.

Sisyrinchium Californicum Hort. Kew. ed. 2, IV.: 135. 1812.

Sisyrinchium lineatum Torrey, Pac. R. R. Rep. IV., 143. 1857.

Sisyrinchium flavidum Kellogg, Proc. Cal. Acad. II.: 50. *t. 3*. 1863.

Mostly 20–30 cm. high (15–60 cm.), dull green and glaucescent, turning dark or often quite black on the herbarium sheet and readily staining a deep purple, roots spreading from a weak descending rootstock. Leaves thin and rather openly weak-nerved, mostly about half the height of the stem but sometimes equaling it, obtusely pointed, commonly 2–4 mm. wide (1.5–7 mm.): stem usually 2–3 mm. wide, sometimes broadly wing-flattened and becoming 6 mm. wide, the edges like those of the leaves smooth or obscurely serrulate-roughened: spathes erect, 3–8 mm. wide in pressed specimens; outer bract 20–52 cm. long, narrowed to an obtuse point, occasionally subequal with the inner one but usually slightly surpassing it and sometimes as much as 20 mm. longer, the margins below narrowly hyaline, often purplish, united-clasping for 5–10 mm.; inner bract 20–35 mm. long, white-scarious and obtuse or obtusely pointed at the apex; interior scales brownish hyaline, often slightly exserted: flowers 3–7, on erect pedicels 20–40 mm. long, usually a little surpassing the bracts, at least the inner ones, and sometimes exserted as much as 10 mm.; perianth bright yellow, 12–18 mm. long, the oblong obtuse or acutish segments with 5–7 black or dark brown nerves which often become tortuous or crinkled when dry: stamens about 7 mm. high, subequal with or surpassing the style branches, the narrow versatile anthers orange-yellow, 3.5–5 mm. long: capsules on erect pedicels, at maturity 7.5–12 mm. long, 6–8 mm. wide, trigonous-obovoid or ellipsoid, becoming very dark: seeds numerous, 1.25–1.5 mm. in diameter, black, strongly pitted, excavated-umbilicate.

Coast region of California, in marshes, perhaps exclusively within maritime influence, from San Diego to Mendocino County, flowering from April to June.

SAN DIEGO, Pac. R. R. Rept. l. c.

MONTEREY Co., C. C. Parry, M.D., April, 1850, in full flower, type of *S. lineatum* Torrey; Mrs. Rich, on sheet with type; Herb. Columbia.

Near the 35th parallel, Dr. J. M. Bigelow, Whipple's expedition, 1853–4.

CONTRA COSTA Co., Antioch, Dr. A. Kellogg, April 21, 1870, just in flower.

SAN FRANCISCO, Mrs. Brandegee; Kellogg and G. W. Harford, 1868; Kellogg, 1866; Presidio, 1887, Edward L. Greene.

SAN MATEO Co., Crystal Springs, April, 1896, Miss Alice Eastwood.

SONOMA Co., Michener and Bioletti, 1892; Bodega Point, Eastwood.

MENDOCINO Co., Bolander, 1866; Eastwood, 1894; H. E. Brown, 1898.

Specimens from "California" have also been examined, collected by Dr. Gibbons (1853), Dr. Coulter and E. Hall.

IRELAND, near Wexford, Rev. E. S. Marshall, June, 1896, fide A. B. Rendle, Journ. Bot. XXXIV., 494.

Numerous specimens covering the extended range of this plant of at least seven hundred miles along the California coast show a great amount of variation and give indications apparently little less than conclusive of two closely allied species within the region.

The type locality of *H. Californicus* is stated to be "Port Bodega" (A. B. Rendle, l. c.), from whence specimens were taken to England over a century ago. Recent collections by Miss Alice Eastwood, made at Bodega Point, Sonoma County, presumably the type locality, are of the form which has been most frequently collected and which shows certain rather suggestive differences from the type specimens of Torrey's *S. lineatum.* As a rule this more northern plant is taller and less discolored from drying with longer and thinner often broader leaves and longer spathes having the outer bract often considerably prolonged, flowers larger, apparently more delicately veined and with the segments less broadened toward the apex, and longer anthers. Present material is not conclusive as to the exact relationship of these two forms, but it would seem that Torrey's specimens may represent a closely allied species of more southern range extending from San Diego to San Francisco, the true *H. Californicus* perhaps not ranging far south of San Francisco. It may be now impossible to determine from Kellogg's description of his *S. flavidum* to which of these plants his name implies. It may be noted, however, that in the Herbarium of the California Academy of Science are two sheets of the more northern plant labelled in pencil "*S. aureum* Kellogg" and another sheet bearing specimens of both plants with penciled memoranda noting their differences. It would appear that these were part of Kellogg's material and since they bear date some years later than the publication of his *S. flavidum* the inference is that he regarded his *S. aureum* as distinct from the latter which would thus be shown to be identical with Torrey's *S. lineatum.*

A somewhat distinct appearing form of the plant which would seem to belong with true *H. Californicus* if two species are ever to be distinguished is indicated by the specimens collected by Dr. Bigelow on Lieutenant Whipple's expedition of 1853–4. These are remarkable for their low stature as compared with their broad leaves and stems, which are 3–6 mm. wide, and their stout spathes; the broad thin wings are notably broadened towards the top of the stem but abruptly contracted at the spathe as in *H. brachypus*, decribed beyond, but unlike the latter the flowers are of the largest size, becoming 18 mm. long, on slightly exserted pedicels, and the spathes are much larger with the outer bract more united-clasping and the inner one less obtuse.

Quite an opposite extreme of development is shown by specimens from Sonoma Co. collected by Michener and Bioletti. These are remarkably tall and slender with short spathes and decidedly exserted pedicels.

Hydastylus borealis sp. nov.

Very close to *H. Californicus* but ordinarily much smaller and more slender, with spathes and flowers about one half the size, much smaller stamineal-column and anthers, smaller capsules and decidedly smaller seeds.

Commonly 15 cm. high (6–30 cm.) not usually turning very dark in drying and when young showing little discoloration; roots usually more slender and delicate than in *H. Californicus*, often much elongated. Leaves commonly only 1–3 mm. wide, rarely 4 mm., often with abruptly linear tip, sometimes even almost subcaudate; stem usually narrower than the leaves: spathe stiffy erect, the inner bract 12–18 mm. long, slightly surpassed by the outer one which is less united-clasping than in *H. Californicus*—usually only 3–4 mm.: flowers on closely erect slightly exserted pedicels 15–22 mm. long; perianth yellow, 8–10 mm. long, the segments apparently mostly five-nerved: stamens 5–6 mm. high, the anthers small, 2–2.5 mm. long: styles 2.5–3 mm. long: capsules ellipsoid, 6–8 mm. long or sometimes narrower obovoid-oblong, and a little longer, 3.5–6 mm. wide: seeds .75–1 mm. in diameter, globose, excavated on one side, finely pitted, often of a semi-transparent reddish color.

Vancouver Island to Whatcom County, Washington, growing on shores of fresh water lakes and flowering from early in July until after the middle of August. Professor Macoun writes "It grows always in soft mud on the margins of fresh water lakes away from the coast."

WASHINGTON: Whatcom Co., W. N. Suksdorf, flowers July 7; fruit August.

VANCOUVER ISLAND: Lake shores, July 1, 1887, first flowers, and Shawnigan Lake, July 12, 1887, John Macoun; Shawnigan Lake, Aug. 18, 1897, fruit and last flowers, Wm. N. Canby; Sooke, Aug. 3, 1893, John Macoun, fruit and last flowers.

The very close affinity of this plant to *H. Californicus* is much more apparent than its diversity; nevertheless, its much smaller average size throughout and especially its smaller flowers, short anthers and small seeds, taken in connection with its inland distribution and lacustrine habits, is certainly sufficient evidence that it cannot be regarded as the same. The question of varietal relationship in cases such as this must always of course, remain merely a matter of conjecture in the absence of conclusive proof.

The present case is almost fatally complicated by the existence in the coast region of Washington and Oregon of yet another form even more closely related to *H. Californicus.* In a way this plant is intermediate between the two but I cannot conscientiously escape the difficulty it presents by referring it to either, nor do I know how to treat it as a variety; neither can it be ignored. The only consistent course therefore is to give it recognition as a closely allied species, even though its entire validity remains to be established. It may therefore be called to notice as *Hydastylus brachypus.*

Hydastylus brachypus sp. nov.

Mostly low and stout, 8–15 cm. high, but becoming twice as tall, leaves and stem broad, 2–5 mm. wide, sometimes narrower, commonly becoming very dark in drying, the leaves abrupt at the apex or short acuminate, mostly obtusely pointed, the stem often very broadly thin-winged, and abruptly contracted below the spathe; roots very slender and delicate: spathes short, the inner bract 15–20 mm. long, mostly broad above and obtusely rounded and scarious at the apex; outer bract abruptly narrowed to an obtuse point, subequal with or but slightly surpassing the inner one, the broad base rather loosely short-clasping for 2–5 mm., the lower margins conspicuously white or purplish-hyaline; interior scales ample, usually slightly exserted: flowers apparently medium sized, the anthers 3–4 mm. long: capsules oblong to broadly ellipsoid, 7–10 mm. long, at maturity crowded together on short pedicels mostly 10–15 mm. long, on large plants becoming 20 mm. long, mostly much shorter than the bracts: seeds black, distinctly pitted and umbilicate, small, .75–1 mm. in diameter.

Coast region of Oregon and Washington. Flowering in June and July.

OREGON: Elihu Hall, 1871; Newport, A. Isabel Mulford, June 1, 1892.

WASHINGTON: Near Gray's Harbor, Wilke's Expedition, 1838–42; Chehalis Co., July 6, 1897, F. H. Lamb; Estuary of the Columbia, Nuttall; low hills of the Columbia, Dr. Scouler.

Very near indeed to *H. Californicus* and often equally stout, but mostly lower, with shorter spathes, broader and less unequal bracts, the inner one more obtuse, smaller flowers, very much shorter pedicels and smaller capsules and seeds.

The plant is mostly much stouter than *H. borealis* with broader and more obtuse leaves and bracts and dries darker; the flowers and capsules are rather larger, although the seeds appear to be equally small; in the specimens examined the seeds are darker, less finely pitted and less widely umbilicate, except in size agreeing more nearly with those of *H. Californicus.* Although a larger plant than *H. borealis*, the pedicels, which are relatively much shorter, are in most specimens absolutely so, say 10–15 mm. as against 15–20 mm.

The exact status of the plant can probably be determined only by critical comparative study in the field.

Hydastylus Elmeri (Greene)

Sisyrinchium Elmeri Greene, Pittonia, **2**: 106. 1890.

Nearly allied to *H. Californicus* but smaller and especially more slender, 15–30 cm. high, not turning dark unless carelessly dried. Leaves half the height of the stem or less, 1–3.5 mm. wide: stems very slender, .75–1.5 mm., rarely 2 mm. wide, very narrowly winged or merely margined, like the leaves sometimes minutely serrulate; bracts of the spathe subequal or the outer one slightly the longer, 16–25 mm. long and united-clasping for mostly 5–6 mm., narrowed or short-attenuate to an obtuse point, the rather narrow inner bract scarious obtuse: flowers yellow, rather closely 5–7-nerved; perianth 10–12 mm. long: stamens 5–7 mm. high: anthers as long as in *H. Californicus* or nearly so, usually 4–5 mm. long; pedicels very slender, 18–23 mm. long, erectly exserted for 1–6 mm.: fruit unknown.

A plant of the Sierra Nevada from northern to middle California, representing there the much larger and stouter *H. Californicus* of the coast.

Though clearly an excellent species as recognized by Professor Greene it can be but poorly understood from existing material. As compared with *H. borealis* it is decidedly more slender with relatively shorter leaves, narrower bracts, longer anthers and more exserted pedicels.

CALIFORNIA: Sierra Nevada, June 28, 1889, Elmer Drew; Type in Herb. Prof. E. L. Greene; Plumas Co., 1876, Mrs. R. M. Austin; Mrs. Ames; Indian Valley, J. G. Lemmon; American Valley, May, 1879, Miss M. A. Plumer.

Hydastylus rivularis sp. nov.

Very small, 3–10 cm. or even 15 cm. high, becoming dull but not turning black in drying, the roots very slender and delicate. Leaves ascending and erect in a short basal tuft, the longer ones 2–6 mm. long, .05–1.5 mm. rarely 3 mm. wide, faintly few-nerved, rather abruptly obtuse, the translucent extreme edges like those of the stem crenulately uneven under a lens; stem straight or outcurved, .05–1 mm. or even 1.5 mm. wide, distinctly thin-winged: spathes straight or deflected, very small, the inner bract 12–17 mm. long, usually surpassing the outer one, the scarious-margined tip obtuse or acutish; outer bract narrowed to an obtuse tip, united-clasping below for 3–6 mm.; interior scales subequal with the bracts, dark-lineate: flowers few, 1–3, on capillary loosely erect or flexuously spreading, much exserted pedicels 15–23 mm. long, surpassing the bracts 5–10 mm., sometimes even twice their length: perianth orange-yellow, 6–8 mm. long, the segments oblong, obtusely pointed, rather openly 5-nerved: stamens 3–5 mm. high, the anthers very small, 2–2.5 mm. long, about the length of the style-branches: seeds apparently few and relatively large.

CALIFORNIA: Fresno Co., Ford of Bubb's Creek, July 5, 1899, in full flower, Miss Alice Eastwood; Mariposa Co., June 3, 1883, J. W. Congdon, first flowers; Eldorado Co., July 13, 1897, first flowers, Ezra Brainerd, wet rocks near Slippery Ford, altitude, 6000 feet.

A diminutive and very delicate plant growing in the wet and sandy or stony margins of fords of mountain streams, and apparently confined to the Sierra Nevadas of middle California.

Its affinity is with *H. Elmeri* and reduced examples of the latter approach it closely, but a wide difference appears between fully developed specimens of the two plants. The very much smaller size and shorter narrower leaves of more delicate texture, the small spathes with elongated inner bract, the small flowers with less close-veined segments, small anthers and mostly flexuously long-exserted pedicels afford a combination of characters which I cannot reconcile with what appear to be the normal characters of *H Elmeri*.

The species is not unlike the smallest examples of *H. borealis* which, however, is normally altogether larger and stouter, with longer and much broader and more acute leaves, larger spathes and flowers, the outer bract the longer, and but little exserted pedicels.

Hydastylus longipes sp. nov.

Pale dull green and glaucescent, not turning dark when dry, from 15 to 30 cm. high, often in narrow tufts. Leaves numerous, mostly about half the height of the stem, closely erect, rather thin, 1–3 mm. wide, narrowed to an obtuse or acutish usually slightly bent point, the almost hyaline edges smooth: stems from less than 1 mm. to 2.5 mm. wide, the narrow wings smooth-edged: spathes sometimes slightly purplish, rather narrow, 1.5–3 mm. wide, erect or a little bent: bracts thin, often only obscurely nerved, outer one 1.7–2.5 cm. long, connate below for 4–6 mm., narrowly hyaline above to the narrowed and obtusely-pointed tip which surpasses the inner bract 2–6 mm.: inner bract much enclosed, the tip white-scarious and obtuse: longer interior scales equaling the inner bract or nearly so: flowers 3–6 on slender, erect, much exserted pedicels 2–3.8 cm. long, sometimes twice the length of the spathes: perianth 8–12 mm. long, apparently orange-yellow, the segments with fine orange or brownish veins, narrowly oblong, rounded or obtusely pointed at apex: stamens 6–7 mm. high, anthers about 4 mm. long: capsules broadly oblong or obovoid-oblong, slightly retuse, 5–7 mm. high, 4–5 mm. wide, thin-walled, turning dark, erect and contiguous: nearly mature seeds irregularly obovoid or subglobose, 1 mm. in diameter, umbilicate, rugulose pitted.

High mountains of Arizona and northern Mexico, flowering from early July until after the middle of August.

ARIZONA: San Francisco mountain, Aug. 18, 1889, fruit and last flowers, F. H. Knowlton; Aug. 4, 1898, 9000–10,000 ft. in meadows, Dr. D. T. MacDougal; Rincon Mts., 7500 ft., 1891, G. C. Neally; Harts Little Spring, July 14, 1892, full flower, E. O. Wooton; J. W. Toumey.

MEXICO: Chihuahua, Sierre Madre, 7500 ft., July 18, 1899, full flower; communicated by Prof. E. O. Wooton.

The aspect of this plant is nearest that of *H. Elmeri* but it is more tufted and leafy with rather broader stem but narrower leaves, rather more prolonged and narrower outer bract, much more exserted pedicels apparently also with less closely and distinctly lineate perianth segments and somewhat shorter anthers.

Hydastylus Schaffneri (Watson)

Sisyrinchium Schaffneri Watson, Proc. Am. Acad. **18**: 160. 1883.

Low, in erect or somewhat depressed leafy tufts, 4–10 cm. high, from short rootstocks bearing pale and apparently soft and somewhat thickened simple roots, dull green, discoloring when dry. Leaves equaling the stems or shorter, very narrow, 0.5–1.5 mm. wide, rather abruptly membranously expanded to a relatively long conduplicate base, narrowed to a very obtuse sub-cartilaginous tip, apparently thickish, the rather obscure fine nerves becoming somewhat prominent in drying, the intervals minutely cross-rugulose or even subscabrellous, the edges smooth or nearly so: stems erect or spreading, narrowly wing-margined, .05–1 mm. wide, rugulose like the leaves and smooth edged or nearly so: spathes mostly deflected, small, 10–15 mm. long, 1.5–2 mm. wide, the bracts subequal or usually the outer one slightly the longer, rugulose, the outer one attenuate to an obtuse tip or sometimes more abruptly narrowed, united-clasping for 3–5 mm., the margins below narrowly hyaline: inner bract less narrowed, scarious obtuse at apex: interior scales subequal with the bracts: flowers few, 3–5, on slenderly exserted, erect or sub-spreading pedicels 15–23 mm. long, exserted 5–8 mm.: perianth yellow, distinctly lineate, about 6–8 mm. long: anthers 2.5–3 mm. long.

Central Mexico, San Luis Potosi, 6000–8000 ft. altitude, no. 881, C. C. Parry and Ed. Palmer, 1878, no. 527, Shaffner.

I have examined three sheets of this type material, two of no. 881. It does not appear that the plant has since been collected.

Hydastylus parvus sp. nov.

Similar to *H. Schaffneri* (Watson) of Mexico, but with broader leaves and stem and larger spathes, the flowers on more exserted pedicels and larger with longer anthers.

Leaves shorter than the stems, mostly 1.5–2 mm. or even 2.5 mm. wide, apparently thinner and rather more distantly nerved than in *H. Schaffneri* and only obscurely if at all rugulose: stem 1.5–2 mm. wide, wing-flattened: spathes 13–18 mm. long, distinctly broader than in *H. Schaffneri*, 2.5–3 mm. wide, the bracts subequal, but often the inner one slightly the longer, the outer one rather more loosely united-clasping than in *H. Schaffneri* and less attenuate, the inner one broader above and more scarious-obtuse; pedicels 23–28 mm. long, usually becoming nearly twice the length of the bracts, erect or diverging: perianth 7–10 mm. long; anthers 3.5–5 mm. long.

MEXICO: "low valley near Saltillo, March 22, 1847, no. 340, Dr. Gregg" just in flower. Type in Herb. Miss. Bot. Gard. and Herb. Columbia.

Hydastylus cernuus sp. nov.

Caespitose in small open tufts 7–18 cm. high from a cluster of pale and delicate fibrillate roots, dull green and glaucescent, turning brown or blackish when dry. Leaves membranously equitant at base, sometimes equaling the stems but mostly shorter, very thin with delicate rather distant nerves often with a fainter alternating series, 1.5–4.5 mm. wide, acuminate to an obtusish point, sometimes obscurely roughened on the sides above, the almost hyaline edges smooth or minutely serrulate: stems erect or ascending, slender, .75–1 mm. wide, delicately wing-margined, the edges smooth to serrulate: spathes erect; outer bract much prolonged, mostly twice the length of the inner one or even longer and surpassing it 5–25 mm., 15–40 mm. long, attenuate to an obtuse point or foliaceously broadened and acuminate, united-clasping for about 5 mm. at base; inner bract 10–15 mm. long, narrow, acutish to obtuse, usually much concealed; interior scales narrow, shorter than the inner bract: flowers very small, 3–5 mm. long, pale yellow, the segments somewhat obtuse, dark-lineate: anthers linear, .05–1 mm. long, the stamens 1.5–2 mm. high: pedicels capillary, becoming 12–18 mm. long, finally slenderly exserted and recurved, the capsules mostly cernuous: capsules pale brown with very thin almost membranous walls taking the impression of the contained seeds, subglobose and 3–5 mm. high to somewhat pyriform and rather longer; seeds mostly 2–4 in each row, sometimes more, large, 1.25–1.5 mm. in diameter, subglobose to broadly oblong, semi-transparent brown, deeply close-pitted and excavated-umbilicate.

MEXICO: Chihuahua; Sept. 7, 1887, fruit mature and last flowers; "High plains between Cusihuiriachic and Guerrero, C. G. Pringle; wet places, Sierra Madre, Oct. 11, 1888, fruit mature and last flowers," C. G. Pringle.

Printed labels refer the older collections of this plant to *H. Schaffneri* from which, however, it may be readily distinguished by much broader leaves, elongated primary bracts and much smaller flowers with very short anthers and recurved pedicels.

Hydastylus subcernuus sp. nov.

Caespitose in small tufts, 6–15 cm. high, the leaves mostly erect, the stems erect or ascending, turning dark brown in drying; roots pale, very delicate and fibrillate. Leaves about half the height of the longer stems, mostly 1.5 mm. wide (1–2 mm.), thin and delicately open-nerved, tapering to an obtuse point, the edges smooth to distantly denticulate: stem 2–15 cm. high, .05–1.5 mm. wide, delicately wing-margined, the thin edges minutely denticulate or usually so: spathes small, the narrow bracts subequal or usually the outer one a little surpassing the inner, sometimes as much as 6 mm. longer, 13–22 mm. long, united-clasping for 5–6 mm., attenuate to an obtuse point; inner bract narrowly obtuse-pointed; interior scales nearly equaling the inner bract: flowers 3–5, small, perianth about 5 mm. long, yellow, delicately dark lineate: stamens about 3–50 mm. long; pedicels capillary, 15–20 mm. long, finally exserted and recurved spreading: capsules less membranous than in *H. cernuus* but similarly moulded over the contained seeds, mostly obovoid-pyriform and 5–6 mm. high: seeds few in a row, larger and rather darker and more coarsely pitted than in *H. cernuus*, 1.5–1.75 mm. in diameter, widely excavated on one side or more or less acetabuliform.

LOWER CALIFORNIA: Sierra de la Laguna, January 22, T. S. Brandegee, type in Herb. Cal. Acad. Sci.

Nearly related to *H. cernuus*, but with narrower leaves, much shorter outer bract, larger flowers with much larger anthers, pedicels less exserted and recurved, capsules rather larger, seeds larger and more coarsely pitted and acetabuliform.

Hydastylus serrulatus sp. nov.

Growing in nearly simple tufts, 14–32 cm. tall, from very delicate and fibrillate nearly simple roots, rather bright transparent green, discoloring but little when carefully dried. Leaves acuminate to an acutish point, 2–5 mm. wide, thin and somewhat translucent, very delicately nerved, the main nerves rather distant with 1–3 fainter nerves in the intervals, rather distantly reticulated with minute cross-veinlets, the edges sharply fine-serrulate: stems 2–5 mm. wide, the stem proper very narrow, the wings very broad and thin, nerved and semi-transparent like the leaves and with serrulate edges: spathes mostly narrower than the stem: outer bract lanceolate-attenuate, 25–37 mm. long, surpassing the inner one 3–12 mm., united clasping 6–8 mm. at the flattened and sharply two-edged base: inner bract attenuate and acutish, 20–25 mm. long: interior scales more than three-quarters the length of the inner bract: capsules 3–6, large, pyriform, narrowed to an almost substipitate base, 8–10 mm. long, on slender, somewhat flexuously spreading pedicels about 25 mm. long: seeds black, subglobose, about 1.5 mm. in diameter, strongly pitted, excavated-umbilicate.

A species very distinct from any of the others here described, characterized especially by the very thin and reticulated semi-transparent leaves, broadly-winged stem and large pyriform capsules.

MEXICO: Orizaba, "in the mountains," Botteri, no. 1856. Type in Herb. Dr. Charles Mohr; Michoacan, 1857, Dr. Carlos Sartorius, Herb. Dr. Charles Mohr.

Hydastylus translucens sp. nov.

Very similar to *H. serrulatus*: glaucescent, the spathes often purplish tinged, 15–25 cm. high, showing more or less discoloration from drying, leaves equaling the stems or nearly so, 2–3.5 mm. wide: as compared with those of *H. serrulatus* longer and narrower, much more slenderly attenuate and even thinner and more translucent, with fewer cross-veinlets, the edges not distinctly serrulate, but wholly smooth except near the apex, or with some very minute or obscure denticulations: stem 1–1.25 mm. wide, the very thin translucent wings much narrower than in *H. serrulatus* and smooth-edged or nearly so: spathes not narrower than the stems, usually somewhat broader, the outer bract usually foliaceously prolonged, 30–47 mm. long, surpassing the inner one 10–25 mm., united-clasping 8–10 mm. above the sharply two-edged base: inner bract 17–22 mm. long, narrow, obtuse or emarginate: interior scales longer than in *H. serrulatus*, equaling the inner bract or nearly so: pedicels very slender and long-exserted, more or less spreading and finally recurved for about half their length, 25–37 mm. long: capsules 3–5, obovoid-oblong or somewhat pyriform, smaller and thinner-walled than in *H. serrulatus*, about 6–7 mm. long: seeds larger than in any other species of the genus at present known, 2–2.5 mm. in longer diameter, flattened acetabuliform, strongly reticulate-pitted.

LOWER CALIFORNIA, Sierra de la Lagura, January 24, some fruit mature. T. S. Brandegee, Herb. Cal. Acad. Sci.

Closely related to *H. serrulatus*, *H. cernuus* and *H. subcernuus* but unmistakably a distinct species, as clearly shown by its much larger seeds, longer outer bract and longer pedicels without regard to other characters. These four plants form a group of closely related species constituting a section of the genus rather obviously distinct from the more northern group represented by *H. Californicus*. The group characters especially to be noted are very thin membranous leaves showing cross-reticulations between the nerves, although these are few or obsolete in *H. cernuus* and *H. subcernuus*, more or less spreading or recurved pedicels and very thin-walled, mostly pyriform capsules.

The Publications of the Department of Botany, Columbia University, consist of Memoirs in quarto and Contributions in octavo.

The Memoirs already published are:—

Vol. I. **Small.** A monograph of the North American species of the genus *Polygonum*. pp. 178. 84 plates. 1895. Price, six dollars.

Vol. II. **Rydberg.** A monograph of the North American Potentilleæ. pp. 224. 112 plates. 1898. Price, six dollars.

The Contributions have now reached the seventh volume.

Vol. I. Nos. 1–25 (1886–1892). Out of print, except Nos. 6, 7, 11, 17, 20, 21, 22, 24. These can be supplied at twenty, five cents each, except No. 6, which is one dollar.

Vol. II. Nos. 26–50 (1892–1894). Nos. 26, 28, 29, 32, 33, 34, 36, 39 and 48 are out of print. Other numbers can be supplied at twenty-five cents each, except No. 35, which is one dollar and a half.

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Lists of titles of Contributions may be had on application.

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY OF COLUMBIA UNIVERSITY—No. 173

NOTES ON THE FLORA OF SOUTH GEORGIA

BY ROLAND M. HARPER

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Notes on the Flora of South Georgia

ROLAND M. HARPER

During the summers of 1895, 1896 and 1897 I devoted most of my time to botanizing in and around Americus, the county seat of Sumter County, Georgia, which was my home at that time. As this region is almost unknown to botanists, I had excellent opportunity to observe many little-known or otherwise interesting plants, some of them far out of their accredited ranges.

Sumter County is situated in the western part of that section known as South Georgia, which includes about 64 counties, with an area of 35,000 square miles, or over half the area of the State. South Georgia is sharply defined both geologically and topographically from the older sections of the State, especially from Middle Georgia, which adjoins it on the northwest. It varies in elevation from sea-level to about 600 feet, and contains three distinct geological formations. Of these, the Cretaceous is represented by a narrow wedge-shaped area in the northwestern portion, and the Quaternary by a narrow strip along the coast and larger rivers, while the remainder belongs to the Tertiary formation.

Sumter County, as far as known, lies entirely in the Tertiary, though its northwestern corner approaches within a short distance of the Cretaceous. The predominating soil in Sumter County, as throughout South Georgia, is sand, generally mixed with more or less clay, organic matter, or marl; the latter being principally confined to the vicinity of the Flint River, on the eastern border of the county.

[Sept. 6, 1900.]

The average annual temperature of Americus is 68° F., with the following averages for the four seasons: spring, 68°; summer, 81°; autumn, 69°; winter, 54°. The average rainfall is for spring, 13 inches; summer, 16; autumn, 8; winter, 10; total for the year, 47. It will be noticed that over one third of the total annual precipitation occurs in the summer, a fact which, no doubt, has its effect on the character of the flora.

Of the numerous floral and agricultural regions into which South Georgia is divided, I have noticed but two principal ones in Sumter County: the red-clay hill region and the pine-barren region. The former seems to correspond with the Lower Eocene formation and the latter with the Middle Eocene. The red-clay hills form a belt extending across the northwestern part of the county, and consist of low, rounded ridges, with broad valleys between them. The pine-barrens are in the southeastern part, and are almost perfectly level throughout. Both regions, like the whole of South Georgia, are characterized by the scarcity of surface rocks, the few that do occur being in the form of small boulders or pebbles.

The city of Americus lies near the dividing line between these two regions, so that I had equal facilities for studying both. With the exception of two trips into Dooly County, on the east, and one each into Schley and Macon Counties on the north, my botanical operations during these three summers were confined to Sumter County. This vicinity is remarkable for the large number of coast plants which here reach their inland limits, 125 miles from the Gulf coast and about 200 from the Atlantic. The region I explored is nearly all north of lat. 32° N. and west of long. 84° W., and at a higher altitude and, of course, farther inland than any point in Florida.

In a preceding number of the BULLETIN I have mentioned the great difference between the floras of Middle and South Georgia. Probably less than one half of the species of spermatophytes in Clarke County are common to Sumter County. On comparing the two floras we find the same kind of differences between them as are said to exist between temperate and tropical regions. In South Georgia the species seem to be more numerous and the individual plants fewer and farther apart (this is especially noticeable in the case of the grasses); there are more evergreen trees and shrubs and fewer evergreen herbs; and there are more species of climbing plants and epiphytic spermatophytes. Comparing the representation of various families in the two regions, we find in South Georgia more species of Cyperaceae, Orchidaceae, Nymphaeaceae, Magnoliaceae, Leguminosae, Euphorbiaceae, Aquifoliaceae, Rhamnaceae, Malvaceae, Hypericaceae, Melastomaceae, Onagraceae, Halorrhagidaceae, Loganiaceae, Gentianaceae, Asclepiadaceae and Rubiaceae; and fewer species of Cupuliferae, Caryophyllaceae, Ranunculaceae, Cruciferae, Crassulaceae, Saxifragaceae, Rosaceae, Violaceae, Cornaceae and Labiatae. To illustrate the deficiencies in some of the latter families, I will mention that I have found the Caryophyllaceae (exclusive of Illecebraceae) and Cruciferae represented only by a few weeds, the Ranunculaceae only by two or three species of *Clematis*, and the Saxifragaceae only by the shrubby genus *Itea*, with a single species.

The flora of South Georgia, at least of that part of it which I have explored, seems to be more highly differentiated into plant-communities than that of Middle Georgia. I have recognized twelve or fifteen distinct floral areas in Sumter County alone, and this number could no doubt be considerably increased by careful study. The plants of this region seem to be more exacting in their requirements for perfect development than those of colder climates, hence there is very little intergradation between the various plant-communities.

I will mention first the strictly aquatic plants, which inhabit ponds and streams, either floating free or rooting in the mud. These are found mostly in artificial mill-ponds, for natural ponds in this region are very small and few and far between. The following aquatics have been observed in Sumter County:

Potamogeton diversifolius Raf.
  lonchites Tuckerm.
Eleocharis interstincta (Vahl) R. & S.
Lemna minor L.
Brasenia purpurea (Mx.) Caspary.
Castalia odorata (Dryand.) Woodv. & Wood.
Myriophyllum heterophyllum Mx.
Limnanthemum lacunosum (Vent.) Griseb.
  aquaticum (Walt.) Britton.
Utricularia inflata Walt.

Most of the above I have found in only one or two localities each. It may be of interest to note that *Limnanthemum aquaticum* may be either a rooting or a floating plant. It seems to make no difference to the plant whether its petioles are attached to the rootstock or not, for I have found the plants in great abundance crowded together along the shore of a pond and floating free, with their petioles broken off below the inflorescence, but with flowers open as usual.

In wet ditches and open muddy places I have found the following species:

Sparganium androcladum (Engelm.) Morong.
Sagittaria latifolia Willd.
Paspalum distichum L.
Dulichium arundinaceum (L.) Britton.
Eleocharis obtusa (Willd.) Schult.
Carex lupulina Muhl.
Orontium aquaticum L.
Polygonum hydropiperoides Mx.
Hypericum mutilum L.
Jussiaea decurrens (Walt.) DC.
Jussiaea leptocarpa Nutt.
Ludwigia alternifolia L.
    glandulosa Walt.
Isnardia palustris L.
Proserpinaca palustris L.
Hydrocotyle umbellata L.
Cynoctonum Mitreola (L.) Britton.
Micranthemum orbiculatum Mx.
Utricularia macrorhyncha Barnhart.

The following are found in alluvial woods and swamps and on muddy banks of creeks and rivers subject to overflow:

Botrychium obliquum Muhl.
Polypodium polypodioides (L.) A. S. Hitchcock.
Taxodium distichum (L.) L. C. Rich.
Juniperus Virginiana L.
Sabal glabra (Mill.) Sarg.
Arundinaria macrosperma Michx.
Scirpus divaricatus Ell.
Rhynchospora corniculata (Lam.) Gray.
Carex folliculata australis Bailey.
Peltandra Virginica (L.) Kunth.
Tillandsia usneoides L.
Commelina hirtella Vahl.
Iris versicolor L.
Habenaria flava (L.) Gray.
Saururus cernuus L.
Populus deltoides Marsh.
Carpinus Caroliniana Walt.
Quercus lyrata Walt.
    Michauxii Nutt.
Boehmeria cylindrica (L.) Willd
Liriodendron Tulipifera L.
Clematis crispa L.
Penthorum sedoides L.
Ilex opaca Ait.
Berchemia scandens (Hill) Trel.
Triadenum petiolatum (Walt.) Britton.
Hydrocotyle verticillata Thunb.
Cornus Amonum Mill.

Nyssa uniflora Wang.
Leucothoë racemosa (L.) Gray.
Fraxinus Americana L.
  Caroliniana Mill.
Chionanthus Virginica L.
Hydrolea quadrivalvis Walt.
Tecoma radicans (L.) DC.
Dianthera Americana L.
Lobelia cardinalis L.
Conoclinium coelestinum (L.) DC.
Pluchea petiolata Cass.

Polypodium and *Tillandsia* are usually epiphytes, but I have included them here because in this region they are mostly confined to river-swamps.

In non-alluvial swamps and wet woods, where the soil consists largely of humus, the flora is quite different from that just mentioned, as may be seen from the following list:

Asplenium Filix-foemina (L.) Bernh.
Osmunda regalis L.
  cinnamomea L.
Arisaema triphyllum (L.) Torr.
Lilium superbum L.
Smilax laurifolia L.
  Walteri Pursh.
Myrica cerifera L.
Alnus rugosa (DuRoi) Koch.
Ulmus alata Mx.
Magnolia glauca L.
Liriodendron Tulipifera L.
Itea Virginica L.
Rosa Carolina L.
Cercis Canadensis L.
Kraunhia frutescens (L.) Greene.
Apios tuberosa Moench.
Liquidambar Styraciflua L.
Rhus Vernix L.
Cyrilla racemiflora Walt.
Ilex glabra (L.) Gray.
Acer rubrum L.
Decodon verticillatus (L.) Ell.
Ludwigia pilosa Walt.
Parthenocissus quinquefolia (L.) Planch.
Aralia spinosa L.
Clethra alnifolia L.
Azalea viscosa L.
Cephalanthus occidentalis L.
Pinckneya pubens Mx.
Sambucus Canadensis L.
Viburnum nudum L.
  dentatum L.
Mikania scandens (L.) Willd.

A number of species grow on the banks of creeks and rivers above the usual high-water mark which are not found in the alluvial swamps lower down. Among these are the following:

Uniola latifolia Mx.
Smilax Bona-nox L.
Salix nigra Marsh.
Betula nigra L.
Fagus Americana Sweet.
Magnolia grandiflora L.
Amelanchier Canadensis (L.) Medic.
Sebastiana ligustrina (Mx.) Müll. Arg.
Passiflora lutea L.
Kalmia latifolia L.
Styrax Americana Lam.
Catalpa bignonioides Walt.
Diodia Virginiana L.

The wet meadows of Sumter County have quite an interesting flora. The following species have been collected mostly in the meadows along Muckalee Creek in Americus:

- *Woodwardia areolata* (L.) Moore.
  - *Virginica* (L.) J. E. Smith.
- *Osmunda regalis* L.
  - *cinnamomea* L.
- *Homalocenchrus oryzoides* (L.) Poll.
- *Cyperus strigosus* L.
- *Kyllinga pumila* Mx.
- *Scirpus Eriophorum* Mx.
- *Rhynchospora glomerata paniculata* (Gray) Chapm.
  - *inexpansa* (Mx.) Vahl.
- *Carex vulpinoidea* Mx.
  - *verrucosa* Muhl.
- *Melanthium Virginicum* L.
- *Lilium Catesbaei* Walt.
- *Habenaria ciliaria* (L.) R. Br.
  - *cristata* (Mx.) R. Br.
- *Gyrostachys praecox* (Walt.) Kuntze.
- *Glottidium Floridanum* DC.
- *Linum striatum* Walt.
- *Hibiscus aculeatus* Walt.
- *Rhexia Virginica* L.
  - *Mariana* L.
- *Ludwigia sphaerocarpa* Ell.
- *Oxypolis rigidus* (L.) Britton.
- *Asclepias lanceolata* Walt.
- *Mentha viridis* L.
- *Mesosphaerum rugosum* (L.) Pollard.
- *Gerardia purpurea* L.
- *Vernonia Noveboracensis* (L.) Willd.
- *Eupatorium purpureum* L.

In sandy or sphagnous bogs are found the following species:

- *Lycopodium Carolinianum* L.
  - *adpressum* (Chapm.) Lloyd & Underw.
- *Campulosus aromaticus* (Walt.) Scribn.
- *Cyperus Haspan* L.
- *Fuirena squarrosa hispida* (Ell.) Chapm.
- *Carex verrucosa* Muhl.
- *Mayaca Aubleti* Mx.
- *Eriocaulon decangulare* L.
- *Tofieldia racemosa* (Walt.) B.S.P.
- *Zygadenus glaberrimus* Mx.
- *Aletris aurea* Walt.
- *Habenaria blephariglottis* (Willd.) Torr.
- *Pogonia ophioglossoides* (L.) Ker.
- *Limodorum tuberosum* L.
- *Sarracenia rubra* Walt.
  - *Drummondii* Croom.
- *Drosera capillaris* Poir.
- *Pyrus arbutifolia* (L.) L. f.
- *Polygala lutea* L.
  - *cruciata ramosior* Nash.
- *Ascyrum stans* Mx.
- *Hypericum fasciulatum* Lam.
  - *pilosum* Walt.
- *Triadenum Virginicum* (L.) Raf.
- *Rotala ramosior* (L.) Koehne.
- *Rhexia ciliosa* Mx.
- *Pieris nitida* (Bartr.) Benth & Hook.
- *Cynoctonum sessilifolium* (Walt.) Gmel.
- *Sabbatia macrophylla* Hook.
- *Bartonia Virginica* (L.) B.S.P.
- *Gratiola pilosa* Mx.
  - *quadridentata* Mx.
- *Oldenlandia uniflora* L.
- *Eupatorium perfoliatum* L.
- *Solidago stricta* Ait.
- *Coreopsis gladiata* Walt.
- *Baldwinia uniflora* Nutt.

In sandy soil which is too dry for a bog, but not dry enough to be loose, a number of interesting species are found. This kind of soil is frequent in the ditches along railroad tracks, and is characterized by the following species:

- *Pteris aquilina* L.
- *Paspalum laeve* Mx.
  - *purpurascens* Ell.
- *Panicum elongatum* Pursh.
- *Cyperus pseudovegetus* Steud.
- *Eleocharis tuberculosa* R. Br.
- *Fimbristylis autumnalis* (L.) R. & S.
- *Scirpus Americanus* Pers.
- *Lipocarpha maculata* (Mx.) Torr.
- *Xyris Caroliniana* Walt.
- *Juncus marginatus* Rostk.
  - *scirpoides* Lam.
- *Lilium Carolinianum* Mx.
- *Eryngium aquaticum* L.
- *Ptilimnium capillaceum* (Mx.) Hollick.
- *Steironema lanceolatum* (Walt.) Gray.
- *Sabbatia angularis* (L.) Pursh.
- *Collinsonia anisata* Sims.
- *Mesosphaerum rugosum* (L.) Pollard.
- *Monniera acuminata* (Walt.) Kuntze.
- *Ilysanthes refracta* (Ell.) Benth.
- *Gerardia purpurea* L.
- *Helianthus angustifolius* L.
- *Helenium autumnale* L.
- *Erechthites hieracifolia* (L.) Raf.

Richest in number of species, particularly in Leguminosae and Compositae, are the comparatively large areas of dry loose sand. The following is a partial list of species inhabiting such areas:

- *Pteris aquilina* L.
- *Pinus palustris* Mill.
- *Andropogon furcatus* Muhl.
- *Cenchrus echinatus* L.
- *Cyperus retrofractus* (L.) Torr.
- *Scleria triglomerata* Mx.
  - *pauciflora* Muhl.
- *Commelina Virginica* L.
- *Chrosperma muscaetoxicum* (Walt.) Kuntze.
- *Yucca filamentosa* L.
- *Agave Virginica* L.
- *Castanea pumila* (L.) Mill.
- *Quercus cinerea* Mx.
- *Eriogonum tomentosum* Mx.
- *Rumex hastatulus* Baldw.
- *Froelichia Floridana* (Nutt.) Moq.
- *Paronychia riparia* Chapm.
- *Clematis reticulata* Walt.
- *Sassafras officinale* Nees & Eberm.
- *Rubus trivialis* Mx.
- *Morongia angustata* (T. & G.) Britton.
- *Cassia Chamaecrista* L.
  - *nictitans* L.
- *Baptisia alba* (L.) R. Br.
  - *lanceolata* (Walt.) Ell.
  - *megacarpa* Chapm.
- *Crotalaria rotundifolia* (Walt.) Poir.
- *Psoralea canescens* Mx.
- *Kuhnistera pinnata* (Walt.) Kuntze.
- *Indigofera Caroliniana* Walt.
- *Zornia bracteata* (Walt.) Gmel.
- *Meibomia stricta* (Pursh) Kuntze.
- *Lespedeza Stuvei* Nutt.

Bradburya Virginiana (L.) Kuntze.
Clitora Mariana L.
Strophostyles umbellata (L.) Britton.
Dolicholus tomentosus (L.) Vail.
  simplicifolius (Walt.) Vail.
  erectus (Walt.) Vail.
Polygala incarnata L.
  polygama Walt.
  Boykinii Nutt.
  grandiflora Walt.
Tragia urticaefolia Mx.
  urens L.
Jatropha stimulosa Mx.
Stillingia sylvatica L.
Euphorbia cordifolia Ell.
Rhus copallina L.
Ceanothus Americanus L.
Vitis aestivalis Mx.
Ascyrum multicaule Mx.
Cfscyrum pumilum Mx.
Hypericum maculatum Walt.
Sarothra gentianoides L.
Lechea villosa Ell.
Opuntia vulgaris Mill.
Gaura Michauxii Spach.
Angelica villosa (Walt.) B.S.P.
Vaccinium arboreum Marsh.
Polypremum procumbens L.
Amsonia angustifolia (Ait.) Michx.
Apocynum cannabinum L.
Asclepias verticillata L.
  amplexicaulis Smith.
  tuberosa L.
Acerates viridiflora (Raf.) Eaton.
Ipomoea pandurata L.
Breweria humistrata (Walt.) Gray.
Cuscuta arvensis Beyr.
Onosmodium Virginianum (L.) A. DC.
Verbena Caroliniana Mx.
Callicarpa Americana L.
Salvia azurea Lam.
Dicerandra linearifolia (Ell.) Benth.
Monarda punctata L.
Trichostema dichotomum L.
Physalis Virginica Mill.
Afzelia pectinata (Pursh) Kuntze.
Dasystoma flava (L.) Wood.
  Virginica (L.) Britton.
Calophanes oblongifolia (Mx.) Don.
Galium hispidulum Mx.
Vernonia angustifolia Mx.
Eupatorium hyssopifolium L.
  album L.
  rotundifolium L.
Lacinaria elegans (Walt.) Kuntze.
  scariosa (L.) Hill.
  tenuifolia (Nutt.) Kuntze.
Chrysopsis Mariana (L.) Nutt.
  graminifolia (Mx.) Nutt.
Isopappus divaricatus (Nutt.) T. & G.
Sericocarpus bifoliatus (Walt.) Porter.
Silphium Asteriscus L.
  compositum Mx.
Berlandiera tomentosa Nutt.
Rudbeckia hirta L.
Tetragonotheca helianthoides L.
Helianthus divaricatus L.
Coreopsis major Walt.
  tripteris L.
Gaillardia lanceolata Mx.
Lygodesmia aphylla (Nutt.) DC.

In South Georgia the flora of roadsides, waste places, and cultivated fields is very similar to that of the dry sand areas, and it is impossible to draw a sharp line between them. Almost any of the sand-loving plants may be found along roadsides or in other artificial localities, but the following seem to be mostly confined to such places :

- *Andropogon scoparius* Mx.
- *Syntherisma sanguinalis* (L.) Krok.
- *Chaetochloa viridis* (L.) Scribn.
- *Sporobolus Indicus* (L.) R. Br.
- *Capriola Dactylon* (L.) Kuntze.
- *Eleusine Indica* (L.) Gaertn.
- *Dactyloctenium AEgyptiacum* (L.) Willd.
- *Cyperus rotundus* L.
- *Stenophyllus capillaris* (L.) Britton.
- *Polygonum Pennsylvanicum* L.
- *Chenopodium ambrosioides* L.
- *Amarantus spinosus* L.
  - *retroflexus* L.
- *Phytolacca decandra* L.
- *Boerhaavia erecta* L.
- *Mollugo verticillata* L.
- *Portulaca oleracea* L.
- *Alsine media* L.
- *Lepidium Virginicum* L.
- *Coronopus didymus* (L.) J. E. Smith.
- *Cardamine hirsuta* L.
- *Rubus nigrobaccus* Bailey.
  - *trivialis* Mx.
- *Albizzia Julibrissin* Durazz.
- *Cassia occidentalis* L.
  - *Tora* L.
- *Lespedeza striata* (Thunb.) H. & A.
- *Oxalis stricta* L.
- *Croton glandulosus* L.
- *Acalypha ostryaefolia* Riddell.
- *Euphorbia Preslii* Guss.
  - *maculata* L.
- *Modiola Caroliniana* (L.) Don.
- *Sida spinosa* L.
- *Passiflora incarnata* L.
- *Onagra biennis* (L.) Scop.
- *Hartmannia speciosa* (Nutt.) Small.
- *Daucus pusillus* Mx.
- *Ipomoea coccinea* L.
  - *purpurea* (L.) Roth.
  - *hederacea* Jacq.
- *Jacquemontia tamnifolia* (L.) Griseb.
- *Cuscuta arvensis* Beyr.
- *Heliotropium Indicum* L.
- *Verbena bracteosa* Mx.
- *Lamium amplexicaule* L.
- *Leonotis nepetaefolia* R. Br.
- *Physalis angulata* L.
- *Solanum nigrum* L.
  - *Carolinense* L.
- *Datura Tatula* L.
- *Plantago major* L.
  - *aristata* Mx.
- *Diodia teres* Walt.
- *Richardsonia scabra* St. Hill.
- *Lonicera Japonica* Thunb.
- *Erigeron Canadensis* L.
- *Ambrosia artemisiaefolia* L.
- *Xanthium strumarium* L.
- *Bidens bipinnata* L.
- *Helenium tenuifolium* Nutt.
- *Anthemis Cotula* L.
- *Acanthospermum australe* (L.) Kuntze.
- *Sitilias Caroliniana* (Walt.) Raf.
- *Lactuca Canadensis* L.

It will be noticed that very few of these are European weeds. Some have been introduced from the West, some from the tropics, and a few from Asia, but the majority are natives of Georgia. It may be worthy of note that there are very few species of troublesome weeds in this section.

The dry or rich woods which are so characteristic of Middle Georgia are of small extent in South Georgia, and comparatively few species inhabit them. In the following list of plants growing in woods I have combined both rich and dry woods, as in South Georgia the two kinds are scarcely distinguishable.

Polystichum acrostichoides (Mx.) Schott.
Uniola longifolia Scribn.
Carex triceps Mx.
Hymenocallis lacera Salisb.
Hypoxis erecta L.
Dioscorea villosa L.
Gyrostachys gracilis (Bigel.) Kuntze.
Tipularia unifolia (Muhl.) B.S.P.
Hexalectris aphyllus (Nutt.) Raf.
Quercus digitata (Marsh.) Sudw.
Phoradendron flavescens (Pursh) Nutt.
Asimina parviflora (Mx.) Dunal.
Persea Borbonia (L.) Spreng.
Hamamelis Virginiana L.
Liquidambar Styraciflua L.
Agrimonia mollis (T. &. G.) Briton.
Psoralea pedunculata (Mill.) Vail.
Stylosanthes biflora (L.) B.S.P.
Meibomia nudiflora (L.) Kuntze.
Falcata comosa (L.) Kuntze.
Phaseolus polystachyus (L.) B.S.P.
AEsculus octandra Marsh.
Vitis rotundifolia Mx.
Ampelopsis arborea (L.) Rusby.
Parthenocissus quinquefolia (L.) Planch.
Sida rhombifolia L.
Aralia spinosa L.
Nyssa sylvatica Marsh.
Oxydendrum arboreum (L.) DC.
Diospyros Virginiana L.
Koellia incana (L.) Kuntze.
Dasystoma pectinata (Nutt.) Benth.
Pedicularis Canadensis L.
Epiphegus Virginiana (L.) Bart.
Ruellia strepens L.
Mitchella repens L.
Galium uniflorum Mx.
Viburnum rufotomentosum Small.
Elephantopus tomentosus L.
Solidago brachyphylla Chapm.
Hieracium Gronovii L.

All the plants mentioned so far are found outside of the pine-barren region. In the pine-barrens the flora is very different, and, to me at least, the most interesting of all.

At this point it might be well to state that the term pine-barren is a very inappropriate one, for the soil of the pine-barrens seems to be just as fertile as any other soil in the region, if not more so. This term is not used by the natives, but has been used so universally in botanical works that it has come to have a very definite meaning.

There are several kinds of pine-barrens, botanically considered. In Sumter County I have distinguished three, differing principally in the amount of water in the soil.

First are the wet pine-barrens, in which the ground is usually covered with water a few inches to a foot or so in depth. I know only one or two such places, but in them I have found the following species:

Pinus palustris Mill.
Rhynchospora corniculata (Lam.) Gray.
  Tracyi Britton.
Pontederia cordata L.
Stillingia aquatica Chapm.
Ilex myrtifolia Walt.
  glabra (L.) Gray.
Hypericum fasciculatum Lam.
Proserpinaca pectinata Lam.
Sabbatia decandra (see p. 432).
  gentianoides Ell.
Gratiola quadridentata Mx.
Monniera Caroliniana (Walt.) Kuntze.
Utricularia purpurea Walt.
  juncea Vahl.
Lobelia Nuttallii R. & S.
Sclerolepis uniflora (Walt.) B.S.P.

In the moist pine-barrens, where there is no standing water on the surface, the species are more numerous, the following being a partial list of them:

Lycopodium alopecuroides L.
Pinus palustris Mill.
Taxodium distichum imbricarium (Nutt.) Sarg.
Rottboellia rugosa Nutt.
Campulosus aromaticus (Walt.) Scribn.
Dichromena latifolia Baldw.
Rhynchospora axillaris (Lam.) Britton.
  microcarpa Baldw.
Tofieldia racemosa (Walt.) B.S.P.
Aletris aurea Walt.
Gyrotheca capitata (Walt.) Morong.
Habenaria nivea (Nutt.) Spreng.
Gyrostachys praecox (Walt.) Kuntze.
Limodorum tuberosum L.
Sarracenia lacunosa Bartr.
Polygala cymosa Walt.
Ilex myrtifolia Walt.
Hypericum myrtifolium Lam.
  virgatum Lam.
Rhexia glabella Mx.
Hydrocotyle repanda Pers.
Sabbatia paniculata (Mx.) Pursh.
  campanulata (L.) Torr.
Acerates Floridana (Lam.) A. S. Hitchcock.
Breweria aquatica (Walt.) Gray.
Gerardia linifolia Nutt.
Trilisa odoratissima (Walt.) Cass.
Chondrophora nudata virgata (Nutt.) Britton.
Aster adnatus Nutt.
Pluchea foetida (L.) B.S.P.
Rudbeckia Mohrii Gray.
Helianthus Radula (Pursh) T. & G.
Coreopsis nudata Nutt.

Most of the herbaceous plants of moist pine-barrens have conspicuous white, yellow, or pink-purple flowers. Among those with white flowers are *Dichromena* (in this case it is the involucre that is colored), *Habenaria nivea*, and *Sabbatia paniculata;* with yellow, *Aletris*, *Gyrotheca*, *Polygala cymosa*, *Hypericum myrtifolium*, *H. virgatum*, *Chondrophora* and *Rudbeckia Mohrii*; and with pink-purple, *Limodorum*, *Rhexia*, *Sabbatia campanulata*, *Breweria*, *Gerardia*, *Trilisa*, and *Coreopsis.* As most of these colored flowers, and several others not mentioned, can generally be found in the same locality and at the same time, it follows that these pine-barrens in summer present a very beautiful appearance; and, all things considered, they are most delightlful places for the botanist.

Lastly may be mentioned the plants of dry pine-barrens, where the surface soil consists of dry sand. These are not of great extent in Sumter County, and their flora is similar to that of the dry sandy fields already mentioned. The following is a list of some of the principal plants of dry pine-barrens:

Pteris aquilina L.
Pinus palustris Mill.
Gymnopogon ambiguus (Mx.) B.S.P.
Crotalaria Purshii DC.
Cracca Virginiana L.
Meibomia arenicola Vail.
Galactia erecta (Walt.) Vail.
Ceanothus microphyllus Mx.
Vaccinium staminenm L.
Asclepias tomentosa Ell.
Lacinaria elegans (Walt.) Kuntze.
  tenuifolia (Nutt.) Kuntze.
Coreopsis lanceolata L.
  delphinifolia Lam.

The four or five hundred species mentioned in the above lists probably represent less than half the number of pteridophytes and spermatophytes in Sumter County.

Below I give an annotated list of species which are little known, or are of interest on account of their distribution.

As there are very few points in this part of the State whose altitudes are known, I do not attempt to give the altitudinal distribution of each species. I will mention, however, that in the city of Americus the altitude ranges from about 300 feet along Muckalee Creek to 400 or more in the central portions of the city. The altitude of the pine-barren region, about 10 miles southeast of Americus is probably about 250 feet, and that of the Flint

River at the southeastern corner of the county, 22 miles from Americus, about 200 feet.

ADIANTUM CAPILLUS-VENERIS L. Sp. Pl. 1096. 1753

Collected at the mouth of a small limestone cave in Dooly County, near the Flint River, August 5, 1896, and July 26, 1897. This seems to be the only known station in Georgia for this rare fern.

LYCOPODIUM ALOPECUROIDES L. Sp. Pl. 1102. 1753

This species is quite common in the moist pine-barrens of Sumter County, where it seems to be the only representative of the genus.

LYCOPODIUM ADPRESSUM (Chapm.) Lloyd & Underwood, Bull. Torr. Club, **27**: 153. *pl. 3. f. 14–18.* Apr. 1900

This species resembles the preceding very much, but never grows with it, as far as I have observed. I have always found it in sandy bogs outside of the pine-barrens. *L. Carolinianum* inhabits similar localities.

TAXODIUM DISTICHUM IMBRICARIUM (Nutt.) Sargent, Sylva N. A., **10**: 152. 1896

On July 26, 1897, I found some small specimens of a *Taxodium* which is evidently referable to this variety, in pine-barrens near Cobb, about three miles west of the Flint River. Although the trees were only about 4 m. tall, they bore considerable fruit. It seems to me that this plant differs sufficiently from *T. distichum* in size, form of leaves, and especially in habitat, to be recognized as a good variety.

JUNIPERUS VIRGINIANA L. Sp. Pl. 1038. 1753

The only place in Georgia where I have seen this tree undoubtedly native is in the Flint River swamps, in Dooly County, where it attains a considerable size. In Middle Georgia it generally has the appearance of being escaped from cultivation.

ROTTBOELLIA RUGOSA Nutt. Gen. **1**: 84. 1818

Collected in moist pine-barrens in the eastern part of Sumter County, August 30, 1897, in flower. I do not find that this species has been reported from so far inland before.

PANICUM ELONGATUM Pursh, Fl. Am. Sept. 69. 1814

Not rare in rather moist sandy soil, Sumter County. Flowers in late summer. This grass does not seem to have been hitherto reported south of North Carolina. Mr. G. V. Nash has kindly identified one of my specimens, collected in Americus, Aug. 22, 1897.

ELEOCHARIS MUTATA (L.) R. & S. Syst. **2**: 155. 1817

Found growing in three or four inches of water in a wet meadow near Ellaville, Schley County, July 24, 1895. I know of no other station in Georgia for this species, and it is certainly not common.

ELEOCHARIS TUBERCULOSA (Mx.) R. & S. Syst. **2**: 152. 1817

In moist sand, Americus, June, 1897. This seems to be its inland and upper altitudinal limit, as far as known, and also the first station in Georgia.

SCIRPUS ATROVIRENS Muhl. Gram. 43. 1817

On June 21, 1897, I collected a fine specimen of this species in a meadow near Muckalee Creek in Americus, thus extending its known range over 200 miles.

SCIRPUS DIVARICATUS Ell. Bot. S. C. & Ga. **1**: 88. *pl. 2. f. 4.* 1816

In alluvial soil along Muckalee Creek, Americus and northward. Not previously reported from Georgia.

RHYNCHOSPORA TRACYI Britton, Trans. N. Y. Acad. **11**: 84. 1892

Ceratoschoenus capitatus Chapm. Fl. S. States, ed. 1, 529. 1860.

Collected in wet pine-barrens in the southern part of Sumter County, July 21, 1897. This station is farther east and about 100 miles farther north and at a higher altitude than any previously known for this species, and is also the first in Georgia.

CAREX FOLLICULATA AUSTRALIS Bailey, Proc. Am. Acad. **22**: 62. 1886

Collected in muddy woods near Muckalee Creek about two miles north of Americus, with *Scirpus divaricatus*, July 3, 1897. Not previously reported from Georgia.

PONTEDERIA CORDATA L. Sp. Pl. 288. 1753.

This species seems to be very rare in Georgia. I have collected it only once, in a pine-barren pond in Sumter County, July 21, 1897. This is probably the only station now known in the State.

LILIUM SUPERBUM L. Sp. Pl. ed. 2, 434. 1762

Grows in rich deep damp woods just south of Americus. This seems to be about 150 miles south of any previously known station.

HYMENOCALLIS LACERA Salisb. Trans. Hort. Soc. **1**: 338. 1812

Collected in rich woods near DeSoto, Sumter County, July 26, 1897, in flower.

TIPULARIA UNIFOLIA (Muhl.) B.S.P. Prel. Cat. N. Y. 51. 1888

In rich woods, under the shade of *Fagus Americana* and *Magnolia grandiflora*, near Muckalee Creek, Americus. Flowers in August.

HEXALECTRIS APHYLLUS (Nutt.) Raf.; Wats. & Coult. in Gray's Man. ed. 6, 501. 1890

In rich woods, Schley and Sumter Counties, flowering in July, very rare. I have only found two or three specimens.

ERIOGONUM TOMENTOSUM Mx. Fl. Bor. Am. **1**: 246. *pl. 24.* 1803

In dry sand, along or near the Flint River, Sumter and Macon Counties, flowering in August. This species has not been reported from farther inland or at a higher altitude.

RUMEX HASTATULUS Baldw.; Ell. Bot. S. C. & Ga. **1**: 416. 1817

In dry sandy soil, Americus. Not previously reported from so far inland in the Atlantic States.

FROELICHIA FLORIDANA (Nutt.) Moq. in DC. Prodr. **13**^{2}: 420. 1849

Grows in dry sand near the Flint River, Sumter County.

PARONYCHIA RIPARIA Chapm. Fl. S. States, ed. 2, 607. 1883

On July 26, 1897, I collected in dry sand along the Flint River a *Paronychia* which I afterward determined to belong to this species, which is known only from the banks of this river. I can find no record of the exact location of the original station, but it is no doubt farther south than mine.

CLEMATIS RETICULATA Walt. Fl. Car. 156. 1788

Common in dry sandy fields and woods about Americus, flowering from June to August.

SARRACENIA DRUMMONDII Croom, Ann. Lyc. N. Y. **4**: 100. *pl. 1.* 1848.

In sandy bogs, ranging from two miles southeast to three miles northwest of Americus; the largest and commonest species of the genus in Sumter County. I have measured specimens whose leaves and scapes were fully a meter tall. Sumter County seems to be the northern limit of this species.

SARRACENIA RUBRA Walt. Fl. Car. 152. 1788

In bogs with *S. Drummondii*, but less common, and only attaining about one fourth of the maximum dimensions of the former. This species on account of its small size and dull coloring is much more easily overlooked, and does not seem to have been collected many times.

SARRACENIA LACUNOSA Bartr. Travels, 415. 1791

S. variolaris Mx. Fl. Bor. Am. **1**: 310. 1803.

Found only in the pine-barrens, where the other two species do not occur. Bartram's description of *S. lacunosa* is sufficiently complete to leave no doubt as to what species he had in mind, and his name antedates that of Michaux by a dozen years. *S. minor* Walt. is still older, but its identity with *S. lacunosa* does not seem to have been established.

DROSERA CAPILLARIS Poir. Encyc. **6**: 299. 1804

In sandy bogs, often with the two *Sarracenias* first mentioned, flowering June to August. This is near its inland limit.

AGRIMONIA MOLLIS (T. & G.) Britton, Bull. Torr. Club, **19**: 221. 1892

In dry woods, Americus, flowering in August. This is one of its southernmost known stations.

BAPTISIA MEGACARPA Chapm.; T. & G. Fl. N. A. **1**: 376. 1838

On July 3, 1897, I found specimens of this species in fruit in dry sandy soil near Muckalee Creek, north of Americus, thus extending its known range northward about 40 miles.

PSORALEA CANESCENS Mx. Fl. Bor. Am. **2**: 57. 1803

In dry sand and dry pine-barrens in the eastern part of Sumter Co., rare. Fruits in July. This seems to be its inland and upper altitudinal limit.

AMORPHA VIRGATA Small, Bull. Torr. Club, **21**: 17. *pl. 171.* 1894

Collected, in fruit, on the bank of Gum Creek, Dooly County, July 26, 1897.

KUHNISTERA PINNATA (Walt.) Kuntze, Rev. Gen. Pl. 192. 1891

Petalostemon corymbosus Mx. Fl. Bor. Am. **2**: 50. 1803.

On Sept. 5, 1897, I collected this curious plant in dry sandy soil on the site of Andersonville Prison, Macon County. At that time its flowers had not begun to open. This seems to be the only definitely known station for it outside of Florida.

GLOTTIDIUM FLORIDANUM DC. Prodr. **2**: 266. 1825

Sebania vesicaria Ell. Bot. S. C. & Ga. **2**: 222. 1824.

Abundant in low grounds near Muckalee Creek, Americus, flowering in August and September. This is probably the highest known station for it. This plant is one of the largest annuals we have, the stem becoming about 3 meters tall and 4 cm. in diameter at the base. In the fall it becomes hard and woody, and I have cut stems in winter which could not be readily distinguished from a woody branch of the same size.

POLYGALA BOYKINII Nutt. Jour. Acad. Phila. **7**: 86. 1834

Collected in dry sandy soil near DeSoto, July 26, 1897.

STILLINGIA AQUATICA Chapm. Fl. S. States, 405. 1860

Found in a wet meadow near Ellaville, July 24, 1895, and in pine-barren ponds, Sumter County, June 26, 1897. The altitude of the former station is about 570 feet, and it is probably the northernmost known for this species.

SEBASTIANA LIGUSTRINA (Mx.) Muell. Arg. in DC. Prodr. **15**^{2}: 1165. 1862

Banks of Muckalee Creek and Flint River, Sumter County. Flowers in June.

EUPHORBIA CORDIFOLIA Ell. Bot. S. C. & Ga. **2**: 656. 1824

Collected in dry sandy fields near Andersonville, September 5, 1897. This is one of its highest and northermost stations.

CEANOTHUS MICROPHYLLUS Mx. Fl. Bor. Am. **1**: 154. 1803

Collected in dry pine-barrens near Huntington, June 26, 1897, at which time its fruit had mostly fallen. This station is on or near its northern limit.

SIDA RHOMBIFOLIA L. Sp. Pl. 684. 1753

Grows in sandy soil, in dry oak groves, Ellaville and Americus, also near Huntington. Flowers in July and August.

HIBISCUS ACULEATUS Walt. Fl. Car. 177. 1788

In wet places near Leslie, Sumter County, flowering in July and August. Northern limit?

HYPERICUM FASCICULATUM Lam. Encyc. **4**: 160. 1797

In pine-barren ponds, growing 1–1.5 meters tall. Without flowers this species strikingly resembles a small coniferous tree, with its shreddy bark, resinous sap, and linear evergreen leaves. Flowers June to August.

HYPERICUM MYRTIFOLIUM Lam. Encyc. **4**: 180. 1797

In moist pine-barrens near Huntington, flowering from June to August. Northwestern limit?

HYPERICUM PILOSUM Walt. Fl. Car. 190. 1788

Sandy bogs near Americus, flowering in August. Inland limit?

ASCYRUM PUMILUM Mx. Fl. Bor. Am. **2**: 177. 1803

Collected in sandy soil near DeSoto, July 26, 1897. This seems to be its northern limit, as far as known.

LUDWIGIA PILOSA Walt. Fl. Car. 89. 1788

Collected in wet places near Leslie, August 31, 1897. This species does not seem to have been collected so far inland before.

JUSSIAEA LEPTOCARPA Nutt. Gen. **1**: 279. 1818

In wet ditches, Americus. This seems to be its northeasternmost known station.

HARTMANNIA SPECIOSA (Nutt.) Small, Bull. Torr. Club, **23**: 181. 1896

Sparingly introduced along roads and railroads, Americus and eastward.

NYSSA UNIFLORA Wang. Beitr. Forstw. Nordam. Holz. 83. *pl. 27. f. 57.* 1787

Grows in the swamps of Muckalee Creek a mile or two below Americus. It probably does not extend much farther from the coast, in Georgia at least.

KALMIA LATIFOLIA L. Sp. Pl. 391. 1753

Forms small thickets on the banks of Muckalee Creek in Americus and a short distance south of the city, with *Magnolia grandiflora.* I know of no more southern station for this species.

FRAXINUS CAROLINIANA Mill. Gard. Dict. ed. 8, no. 6. 1788

In Muckalee Creek swamps below Americus. Inland limit?

CHIONANTHUS VIRGINICA L. Sp. Pl. 8. 1753

On muddy banks of Muckalee Creek below Americus, with *Sabal glabra, Quercus lyrata, Nyssa uniflora, Fraxinus Caroliniana,* etc. Here it becomes a tree 6–8 meters tall and about 3 dm. in diameter at the base, appearing very different from the shrub which represents the species in Middle Georgia. Not noticing that its leaves were opposite, I mistook this *Chionanthus* tree for a *Nyssa* for two or three years, and it appears that the same mistake has been make by collectors in other states.

CYNOCTONUM SESSILIFOLIUM (Walt.) Gmel. Syst. **2**: 443. 1791

Occurs in sandy bogs near Americus, flowering in July and August. Inland limit.

SABBATIA MACROPHYLLA Hook. Comp. Bot. Mag. **1**: 171. 1835

Grows in a sphagnous bog north of Americus, at an altitude of about 350 feet. It is accompanied by *Sarracenia rubra*, *S. Drummondii*, *Pogonia ophioglossoides*, *Polygala cruciata ramosior*, *P. lutea*, etc., and flowers in July. This is probably the highest known station for this species. It has been previously reported only from near the Gulf coast.

Sabbatia decandra (Walt.)

Chironia decandra Walt. Fl. Car. 95. 1788.

Sabbatia chloroides var. *erecta* Ell. Bot. S. C. & Ga. **1**: 286. 1817.

Sabbatia chloroides var. *stricta* Griseb. Gen. et Sp. Gent. 125. 1839; also in DC. Prodr. **9**: 50. 1845. Gray, Syn. Fl. N. A. 115. 1886.

Sabbatia dodecandra stricta Mohr, Bull. Torr. Club, **24**: 26. 1897.

Although Walter's description of this species ("flor. decemfidis colore dodecandrae, foliis linearibus, caule rigido erecto") is rather brief, still there is no other known plant in the southeastern states which answers it exactly, and as his name for the species is cited as a synonym by both Elliott and Grisebach, no hesitation is felt in taking it up here.

That it is a species distinct from *S. dodecandra* (L.) B.S.P. (*S. chloroides* Pursh) there can be no doubt after comparing specimens of the two. One important and apparently constant distinguishing character, which seems to have been hitherto overlooked, is found in the calyx-segments. These in *S. decandra* are semicircular in cross-section, and awl-shaped, while in *S. dodecandra* they are flat, and of about the same width from the base to near the apex. *S. decandra* is one of the most beautiful and conspicuous plants of the wet pine-barrens of Sumter County, where it flowers in July and August. Besides my own specimens, collected July 21, 1897, the following in the herbaria of Columbia University and the New York Botanical Garden, all from Florida, are referred here:

DUVAL CO.: *A. H. Curtiss*, July (no. 2231); near Jacksonville, *H. D. Keeler*, 1870–76, *A. H. Curtiss*, July 10, 1893 (no.

4374), July 16, 1894 (no. 5050); Baldwin, *G. V. Nash*, July 20, 1895 (no. 2250); Pablo, *L. H. Lighthipe*, July 11, 1896 (no. 372).

Between Quincy and Aspalaga, and near St. Marks, *Rugel*, July, 1843. Without definite locality or date: *Allison* (no. 329); *Chapman*.

SABBATIA GENTIANOIDES Ell. Bot. S. C. & Ga. **1**: 286. 1817

With the preceding, flowering at the same time, and with very similar flowers. Both probably reach their inland and upper altitudinal limits here.

ASCLEPIAS AMPLEXICAULIS Smith, Georgia Insects **1**: 13. *pl. 7.* 1797

A. obtusifolia Mx. Fl. Bor. Am. **1**: 115. 1803.

Grows in dry sandy soil north of Americus; not common.

ASCLEPIAS TOMENTOSA Ell. Bot. S. C. & Ga. **1**: 321. 1817

In dry pine-barrens between Huntington and Leslie, flowering in July and August. I find no record of any station farther north than this.

JACQUEMONTIA TAMNIFOLIA (L.) Griseb. Fl. Brit. W. I., 474

In sandy soil, especially in cultivated fields, Americus and eastward. This is near its northern limit.

BREWERIA AQUATICA (Walt.) Gray, Syn. Fl. N. A. **2**^{1}: 217. 1878

In moist pine-barrens near Huntington, June 26, 1897. I do not find that this species has been previously reported from Georgia.

CUSCUTA COMPACTA Juss.; Choisy, Mem. Soc. Gen. **9**: 281. *pl. 4. f. 2.* 1841.

On various shrubs, especially about the edges of swamps, common. Flowers in September.

DICERANDRA LINEARIFOLIA (Ell.) Benth. in DC. Prodr. **12**: 243. 1848

Ceranthera linearifolia Ell. Bot. S. C. & Ga. **2**: 94. 1821.

Collected in dry sandy soil near Andersonville, Sept. 5, 1897. The place where I found this plant answers very well Elliott's description of the type locality, which is "high pine-barren ridges between the Flint and Chatahouchie rivers." The original station was probably farther south than mine however.

MESOSPHAERUM RUGOSUM (L.) Pollard, Bull. Torr. Club, **24**: 156. 1897

Hyptis radiata Willd. Sp. Pl. **3**: 84. 1081.

Grows in moist sandy places in the eastern part of Sumter County. Flowers. Northern limit?

LEONOTIS NEPETAEFOLIA R. Br. Hort. Kew. ed. 2, **3**: 409. 1811

I have found this showy weed along sandy roadsides at two or three localities north and east of Americus.

GRATIOLA QUADRIDENTATA Mx. Fl. Bor. Am. **1**: 6. 1803

In wet pine-barrens and sandy bogs, Sumter County.

GERARDIA LINIFOLIA Nutt. Gen. **2**: 47. 1818

Collected in moist pine-barrens near Huntington, Aug. 30–31, 1897, in flower. Not previously reported from Georgia.

UTRICULARIA MACRORHYNCHA Barnhart, Bull. Torr. Club, **25**: 515. 1898

Grows in wet muddy or sandy places; the commonest *Utricularia* in Sumter County. This species has been previously reported only from Florida.

EPIPHEGUS VIRGINIANA (L.) Bart. Comp. Fl. Phila. **2**: 50. 1818

Found only in "Magnolia Dell" near Muckalee Creek, Americus, under *Fagus Americana.*

CATALPA BIGNONIOIDES Walt. Fl. Car. 64. 1788

Grows on high banks of the Flint River, on the Sumter County side. There has been some uncertainty as to the native habitat of this species, but the evidence is strongly in favor of its being native in Georgia. The locality above mentioned is in a region remote from human habitations, where there are no introduced plants within many miles, so that it is extremely improbable that the *Catalpa* could have been introduced.

RICHARDSONIA SCABRA St. Hil. Pl. Us. Bres. 7: *pl. 8*

Not rare in sandy waste places and cultivated fields, Americus.

PINCKNEYA PUBENS Mx. Fl. Bor. Am. 1: 105. *pl. 13.* 1803

This unique and interesting shrub is quite common in non-alluvial swamps in Sumter County, and flowers in June and July. It has not previously been reported so far from the coast or at so high an altitude.

VIBURNUM DENTATUM L. Sp. Pl. 268. 1753

Grows in a swampy place near Barlow's Mill, Sumter County, where it flowers in September. This seems to be its southern limit.

LACINARIA ELEGANS (Walt.) Kuntze, Rev. Gen. Pl. 349. 1891

In dry sandy soil east and west of Americus, flowering in August and September. According to my observations the corollas in this species are invariably pure white, a fact which does not seem to have been noted before.

ASTER ADNATUS Nutt. Jour. Acad. Phila. 7: 82. 1834

Not rare in moist pine-barrens east of Huntington. Previously known only from Florida and Alabama. The flowers of this species must be very late, for no trace of them is visible at the end of August.

RUDBECKIA MOHRII Gray, Proc. Am. Acad. 17: 217. 1882

R. bupleuroides Shuttl.; Chapm. Fl. S. States, ed. 2, 629, 1883.

One of the characteristic plants of moist pine-barrens in the southeastern part of Sumter County, flowering from June to the end of August. This makes the third known station for this species. the other two being in West Florida, about 125 miles farther south and 200 feet lower.

HELIANTHUS RADULA (Pursh) T. & G. Fl. N. A. 2: 321. 1842

In moist pine-barrens, flowering in September. Sumter County seems to be its northern limit, as far as known.

COREOPSIS NUDATA Nutt. Gen. 2: 180. 1818

Collected in moist pine-barrens near Huntington, June 26, 1897, in flower. Previously known only from Florida and the adjacent coast of Georgia. The type-locality of this species is given by Nuttall as "St. Mary's, West Florida," but St. Mary's is in southeastern Georgia.

LYGODESMIA APHYLLA (Nutt.) DC. Prodr. 7: 198. 1838

Collected in dry sand near the Flint River, in Dooly County, July 26, 1897. The type-locality and previously known range of this species are the same as in the case of *Coreopsis nudata.*

COLUMBIA UNIVERSITY.

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CONTRIBUTIONS FROM THE DEPARTMENT OF BOTANY,
COLUMBIA UNIVERSITY—No. 174.

THE INSULAR FLORA OF MISSISSIPPI AND LOUISIANA.

BY FRANCIS E. LLOYD AND S. M. TRACY.

NEW YORK
1901

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The insular Flora of Mississippi and Louisiana

BY FRANCIS E. LLOYD AND S. M. TRACY

(WITH PLATES 8-11)

During the summer of 1900 the writers made a brief ecological survey of the more westerly islands of the Mississippi Sound Islands and Delta. The islands visited were Ship Island, Ile à Pitre, Sundown Island, Sam Holmes Island, Mitchell Key, Brush Island, Battledore Island, the Hog Islands, Breton Island, the Bird Islands, and the Mud Lumps. The Delta proper was visited at two points in the South Pass, namely, at Port Eads and at a point a few miles north of that place. The field work was done during the three weeks between the 10th of August and the 1st of September, at a time when the summer vegetation is at its height.

In order that the present avowedly brief and imperfect study may be made of definite interest, a comparison has been instituted between the region here considered and the island of Ocracoke, the only point on the coast of North America which has so far received careful ecological study, and which, according to Kearney's results, lies "well within the lower austral life zone in North America." (5) The region here considered occurs in the longitudinal center of the Gulf Strip of the Austro-riparian. Between the two regions the difference of longitude is about thirteen degrees, of latitude five degrees. What the significance of this difference is will be seen the better by a comparison of the climatic conditions.

[Issued 2 March.]

CLIMATE

The data here used have been derived from the Annual Report of the Monthly Weather Review for the past eight years, the New Orleans data being used.

TEMPERATURE

The mean annual temperature of the Delta is near 21.1° C., while that of Ocracoke is 16.3° C., a mean difference of nearly 4.9° C. (9.0° F.). The maximum temperature is 36.1° C. (97.0° F.), and the minimum — 16.1° C. (7.0° F.), the lowest and highest points registered in eight years. In this regard the two places differ but little. As the accompanying curves (Fig. 1) will show, however, the general temperature is higher, and the growing season longer, at the more southern point, as shown by the more rapid rise of the curve after the middle of February, and the steady maintenance of an effective growing temperature in the earlier and later months of the growing season. And in this lies the chief climatic difference of physiological moment between the two places here under consideration.

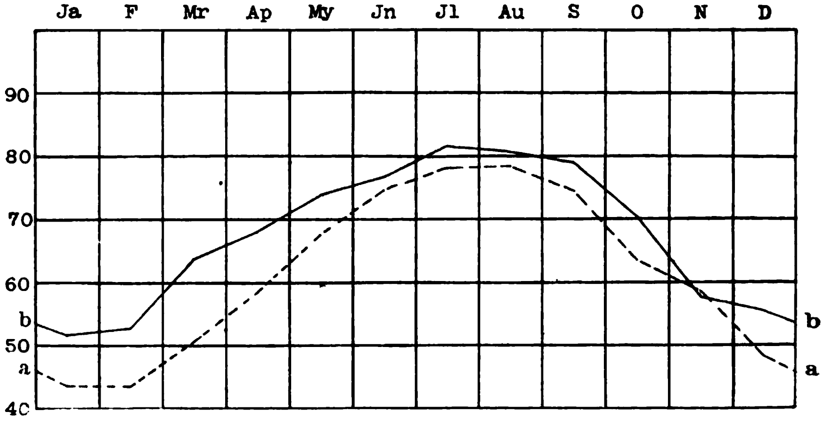

FIG. 1. Curves showing the mean monthly temperatures of Hatteras (*a–a*) and the Mississippi Delta (*b–b*).

One might readily suspect that the meteorological observations made at New Orleans would show some variation from the conditions found on the small islands of the Delta and adjacent parts. A comparison of data taken at New Orleans and the rather fragmentary official collection of data from Port Eads, at the southern end of the South Pass, indicates that the temperature variations between these two places are slight. As the latter place may thus be taken as a criterion of the conditions on the islands, we may regard the New Orleans data as fairly close to the truth.

It may, however, be mentioned in passing that our own observations during two weeks of August spent among the islands proper showed a range of temperature between 26.6° C. and 30° C. and a maximum daily range of only 3.4° C., the readings being taken in the shade. It may also be mentioned in this connection that the water temperatures showed about the same amount of variation (27.1°–30.5° C.), and a mean temperature higher than that of the air by 0.5°–1° C. This continual high temperature of the waters is due undoubtedly to their extreme shallowness over large areas.

PRECIPITATION

The precipitation of this region is heavy and is composed almost entirely of rain. The records show a mean annual rainfall of about 154.94 cm. (61 inches), less by 16.51 cm. (6½ inches) than than that of Ocracoke. This difference is of little or no physiological importance because the vegetation is near the water table, and because of the continuous high relative humidity. Only one other region on the Atlantic Coast has as great a rainfall as the Hatteras region and the one here considered, namely a part of southern Florida. The Delta region, however, is somewhat more subject to sudden storms than Hatteras as is indicated by the relative frequency of thunder storms in the ratio of 4 to 3. Droughts do not occur, as the rainfall is pretty evenly distributed throughout the year, and there appears to be little or no tendency to concentrate it at any season of the year. Thus a given month which shows six or seven inches in one year may show as low an amount as one or two in another year.

ATMOSPHERIC HUMIDITY

The percentage of possible saturation of the air may vary between 66 and 84, the annual average being 77, less by 4.4 per cent. than that of Ocracoke. The degree of humidity is however, high, and varies but little from month to month.

SUNSHINE

The data available are those based upon six years' observation. These show that the average number of cloudless days per annum in this region is 154 against 141 at Hatteras, while the average number of totally cloudy days for the two places is very nearly the same. The average total number of partly cloudy days is accordingly less for the Delta region (117 to 130) giving that region an amount of sunshine greater by about 21 days. This and the lower relative humidity of the atmosphere, indicate an amount of energy available in the form of light considerably greater than at the more northern station, namely Ocracoke.

WIND

The average velocity of the wind is very near to 13.2 kilometers (8.2 miles) (Hatteras, 21.4 kilometers (13.3 miles)) and the total wind movement per annum, 118740.3 kilometers (73,619 miles) as compared with a wind movement of 191,935.5 kilometers (119,000 miles) at Hatteras.* The total wind force is therefore small. The prevailing direction of the wind is southeast. The total wind movements, however, from the south points of the compass exceed those from the north points by only a little, and are to each other in the ratio of 10 to 8. This fairly equal distribution of winds about the points of the compass accounts for the absence, for the most part, of those asymmetrical growth forms which are referred to the mechanical action of the wind. The direction of the wind in summer months is almost constantly southeast and the small amount of distorted growth is due to this fact as the direction which that growth takes indicates.

Summing up the above data the climate of the delta region may briefly be described as having: (1) A very long growing season, as shown by the sudden rise of the curve in the accompanying figure (Fig. 1), after the middle of January; (2) A large amount of precipitation well distributed throughout the year; (3) A high relative humidity with little annual variation; (4) A high degree of insolation, the effect of which is somewhat lessened by the high relative humidity, and (5) A relatively small wind force well distributed as to direction. These factors are on the whole quite favorable to plant growth.

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* Based on six years' observations.

SOIL TEMPERATURES

A number of observations were made by means of a properly calibrated soil thermometer. Temperatures on the surface and at a depth of 10 cm. were taken on clear days and indicate the amount of heat to which the vegetation is exposed in ordinary summer weather. The results are as follows:

Surface of wet sand, 36° C.
Wet sand, 10 cm. deep, 32° C.
Surface of dry sand dune, 35.5° C.
Dry sand at 10 cm. 32° C.
(Air temp. at same time, 30° C.)

At a point near Port Eads, where some coal dust had been mixed with the alluvium, and where some euphorbias and a few other strictly radiate plants were growing, the surface temperature was 50° C. The surface temperature of sun-baked alluvium at 10–30 on the same day was 44° C. Here crotons, sidas and some other plants were found plentifully.

The temperature of the surface of a salt muck marsh was 38° C., and at a depth of 10 cm. 31° C.

These observations, though scanty, indicate a high soil temperature which probably often exceeds that observed.

GENERAL PHYSIOGRAPHIC FEATURES

The islands visited are of three distinct types: (1) The muck marsh islands; (2) The sand islands; (3) The mud lumps. They owe their origin to deposits of drift and alluvium from the Mississippi River. Of the first group Ile à Pitre, Sundown, and Sam Holmes Islands are types; Ship, Cat, and Breton Islands belong to the second type, while the third, the "mud lumps," consists of a large number of nameless islands just outside the several passes which form the main outlets of the river.

1. *The Muck Marsh Islands.*—These are near the outlet of Lake Borgne, Cubits Gap, Thompson's Pass, and the numerous bayous above the mouth of the river and are probably of the most recent formation. They are low, level and mostly small, many of

them being only a few acres in extent. They are composed of a very fine black alluvium which is so soft that a pole or an oar can be pushed into it one or two metres with very little exertion, and the soil seems to be held in place principally by interlacing roots of maritime plants. The water between these islands is usually shallow, seldom being over 1.6 meters in depth, and always more or less cloudy from the admixture of muddy water from the river.

Oysters are very abundant in the brackish waters, and the islands situated in the oyster region and exposed to violent wave-action often have a beach from two to several meters in width, formed of shells which are more or less broken. In all cases this beach is found only on the seaward side of the islands, and always resting on a foundation of black muck. In nearly all cases the muck foundation is bare and plantless from 0.5 to 2 meters from the water line; then comes a ridge of shells from two meters to sometimes as much as twenty meters in width and from 3 dm. to a meter high, the crest being near the river side, and the inner slope very abrupt. These shell beaches are found only on the shores of the muck marsh islands.

2. *The Sand Islands.*—These islands are from five to fifteen miles from the mainland, outside of Mississippi Sound, and probably owe their origin to the same causes which formed the muck marsh islands, though they are now covered for the greater part with sand. A close examination will usually show that a part of each one has the black, mucky foundation of the marsh islands, and if not found elsewhere some remains of this original soil can usually be found on the southeast side of the island where it is most exposed to erosion by winds and waves. All of these sand islands are moving to the northwest, in the direction of the prevailing winds. The southeastern shore is usually abrupt, with deep water within a few meters of the beach, while in nearly all cases the western end of the island is a long and almost barren sand spit, and often extending a mile or more farther in the form of a sand bar which is uncovered at low tide. The sand covering of these islands is only a few centimeters deep in some places and so low as to be constantly wet, forming sand marshes, while in other places the surface is raised from one to three meters, or even into dunes twenty-five meters in height, as on Cat Island. Of course

the amount of moisture in the sand varies with its elevation above tide and the greatest variety in flora is found on the largest islands having the greatest variety of soil and elevation.

3. *The Mud Lumps.*—The mud lumps vary in size from a few square rods to perhaps fifty acres. The general surface is somewhat undulating, and from one to three meters above tide. The soil is very compact, black or yellowish, with almost the texture of joint clay. None of these islands showed any of the usual signs of growth on any side, while all appear to be wearing slowly from wave action.

The contiguous waters are very shallow and the amount of salt held in suspension is considerable, decreasing as one passes seaward. The algal vegetation is small, even in the most favorable locality visited, Breton Island, and is to be found chiefly in the lee of the island. The collection has not yet been studied, and remains to be reported upon later.

Such extensive shallow waters, especially in the lee of an island, favor the extensive growth of *Ruppia*, with, however, scarcely any other plant save the few algae.

THE PLANT COVERING

Any attempt to present an analysis of the floral covering of the region just briefly described must of necessity be more or less unsatisfactory, for an analysis attempts to present the conditions as they are, while in point of effect we are dealing with a series of changes in those conditions. It must be admitted also that but few plants are habitually confined to one association, or even formation, and to delimit these is often no easy task, involving much more time in the field than the writers have had at their disposal. The following account may be claimed to be a fairly true picture of the conditions described, but would probably need revision as to details on subsequent investigation.

SAND STRAND VEGETATION

Beach formation.

Lower beach: no vegetation.
Middle beach.
Upper beach: *Panicum amarum* association.

Sand plain formation.
- Sand spit plain: open, treeless, subject to inundation.
    - Basins: *Hydrocotyle* association.
    - Dunes.
        - Grass dunes: *Panicum repens.*
        - Pedestal dunes: *Iva, Serenoa.*
    - Flats: *Cyperus.*
- Grass-covered sand plain, not subject to inundation.
- Established sand plain, tree-covered, not subject to inundation.
    - *Pinus-Sabal* association.
    - *Quercus geminata* association.

Sand dune formation.
- Established dunes of low stature; *Myrica-Ilex* association.
- High, wandering dunes.

SHELL STRAND VEGETATION

Shell-dune formation.
- Shell beach.
    - Lower.
    - Middle: *Euphorbia-Strophostyles* association.
    - Upper: *Iva frutescens-Lycium* association.

SALT MARSH VEGETATION

Muck marsh formation.
- *Batis-Salicornia* association.
- Grass associations.
    - Pure.
    - Mixed.

Shell-muck marsh formation.

Sand marsh formation.
- Sand-muck marsh: *Juncus* association.
- Sand (pure) marsh.

SAND STRAND VEGETATION

Beach Formation (*Plate 8*)

As one would expect, in a region where the water is very shallow the beaches are wide and have a very gentle slope. Such beaches are also subject to the action of the waves, and the plants which grow in this habitat are therefore exposed to the danger of wave action, as well as that of the wind. Their roots are of course in strictly saline conditions. There is little or no movement of the substratum due to the effect of the wind, at least in ordinary times, inasmuch as the sand is compacted by the water of capillarity.

Here as elsewhere according to the studies of Macmillan, Cowles, Kearney, and others in this country, the beach formation is readily divided into three main zones, namely the lower, middle and upper beaches. As the tides are here quite slight the lower beach is narrow as compared to that in most maritime regions. Vegetation is either entirely absent, or there may be at most a meagre and inconstant algal association. The middle beach (mid-strand) is relatively broad and the physiological conditions are extremely unfavorable on account of the above-mentioned saline soil conditions and on account also of the intense light and heat aggravated by the strongly reflecting surface of the sand. The plant covering is very sparse consisting of succulent annuals of the cespitose and radiant habit of growth. Two zones are distinguishable, an outer, seaward zone occupied chiefly by cespitose forms such as *Dondia linearis*, *Cakile fusiformis* and *Salsola Kali*, with the grass *Cenchrus megacephalus* which grows nowhere else. Towards the upper limit of this zone the radiant form *Sesuvium portulacastrum* is to be found, but no such massing of this plant such as was seen by Boergesen and Paulsen in the Danish Anti les has been observed. *Eragrostis secundaeflora*, is also a beach plant and responds to the high humidity of the region after the manner of some other grasses (*Poa alpina*, *e. g.*) to similar conditions, by becoming strongly proliferous. The inner, landward zone is characterized by a growth of *Ipomoea Pes-caprae*,* *I. acetosaefolia*, *Strophostyles helvola* and sometimes *Canavalia obtusaefolia*. These, with the exception of *Strophostyles*, are preëminently tropical strand plants whose ecological features have been described by Warming, Schimper, and others. All of these three forms reduced the layer of over-insolation by bringing the leaf's surface into a vertical position, *Ipomoea Pes-caprae* by folding the leaf at the midrib, *I. acetosaefolia* by folding the lobes of the leaf on their chief veins, and *Canavalia* by bringing the leaflets separately into the vertical by means of the motile organs at their bases.

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* Stems of immature plants 30 meters long, were found. Dr. H. J. Webber tells me (F. E. L.) that he has measured stems nearly four times this length on the Florida coast.

Strophostyles helvola, on the other hand, is a plant of wide northern distribution. It is of much smaller stature, but has very much the same ecological development as *Canavalia*. No one of these plants may be described as dominant in this region, except in one restricted locality on Breton Island where the two species of *Ipomoea* form a network covering the soil much as described by Schimper. (See Plate 8.) They do not, however, even here serve to attract other plants and the association is poor in species. Associated with the just mentioned prostrate forms are a few sedges and some grasses, notably *Spartina* and *Panicum amarum*, the latter in isolated clumps between which usually germinate the seeds of the prostrate vines already named and from which the plants extend their runners in various directions, but chiefly toward the lower beach.

The upper beach extends from the upper limit of high water and ordinary wave action, and shades off on the inner side into a sand plain formation to be considered beyond. The name upper beach is less appropriate than back strand, because the zone, properly speaking, is not a beach, as Cowles has pointed out. The term strand has, however, been given a much wider application, so we choose for our present purposes the word beach. The upper beach, then, is composed of very low dunes, caused by accumulations of sand about the grass, *Panicum amarum*, which here attains full development. Associated with *Panicum amarum*, a maritime plant found as far north as Long Island, is another large grass of more southern distribution, *Uniola paniculata*, which grows in scattered clumps, adding to the otherwise monotonous grass of the beach dune vegetation a very striking element of beauty in its gracefully curved large inflorescences. *Uniola paniculata* is, however, of much less importance as a sand-binding grass than it appears to be on the east coast of Florida or on Ocracoke, according to Webber (11) and Kearney (6), respectively. The quantitative relation, stated by Webber, namely, that in Florida it forms 75 per cent. of the vegetation is about reversed, *Panicum amarum* taking the lead to that extent.

Yucca gloriosa also appears occasionally as a striking feature of the beach dunes, as was observed on Breton Island.

Panicum amarum appears to correspond in its habitat and behavior to *Spinifex squarrosus* of New Zealand, as described by Schimper.*

The upper beach association may at times consist wholly of three plants, *Panicum amarum*, *Ipomoea Pes-caprae* and *I. acetosaefolia* (Plate 8). This occurs if the width of the island is not great enough to permit the growth of vegetation in the lee of the dunes. If, however, as occurs in the older, wider portions of an island, an accumulation of sand of some depth has taken place, or if the island has been extended into a sand spit of considerable area, other conditions are set up which we describe under the following head.

The Sand Plain Formation (*Plates 9 and 10*)

Floristically considered there are three leading types of the sand plain. These may be distinguished also by age, in the order of which they may very properly be described.

The youngest is the sand spit plain. This is usually a low-lying extent of sand, hot, brilliantly lighted and wind swept. It is also subject to inundation by the sea during heavy weather (Hilgard). Being continuous with the older part of the island, their beaches are continuous. The lower beach of the sand spit is less steep and strand pools are of frequent occurrence. The middle beach is in like manner less abrupt, and is coördinately much broader. The dunes of the upper beach may usually be followed for some distance from the older part of the island, but they sooner or later fail. The whole area of the plain is then open to the sea without the protection offered by the dunes, and produces a scattered vegetation of the beach annuals together with perennials of similar ecological character.

The occurrence of driftwood or of plants on the plain causes irregularities in the surface. These are of the form : (1) Of shallow depressions or basins of small extent usually below the general level and very generally wet ; (2) Of low dunes ; and (3) Of more or less level stretches of sand.

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* **Pflanzengeographie auf physiologische Grundlage.**

In the basins one finds a scanty vegetation, a species of *Hydrocotyle* being the most constant element. The plant has prostrate buried stems and only the leaves and inflorescences appear above the surface. The petioles are vertically placed and the peltate leaf-blades are also strictly vertical, although no orientation was observed. *Mollugo verticillata* is to be found here also.

In the second place the surface may be raised locally into dunes of usually inconsiderable size. The dune formers are the grasses on the one hand (*Panicum repens* and *P. halophilum*) and chiefly two perennials, *Iva imbricata* and *Serenoa serrulata*, which here grow in symmetrical cespitose clumps and gradually collect about their bases a dune upon which they raise themselves above the general level, and so become raised upon a pedestal of sand. For this reason the name pedestal dune appears to be appropriate to this dune form. The absence of strong continuous winds may account for the ability of these plants to act in this manner.

Extending between the elevations and depressions are more or less level reaches where a number of plants grow whose form does not favor the accumulation of sand about them, plants namely which do not tend to produce a network of stems, such for example as some sedges (*Scirpus Americanus*, *Cyperus cylindricus*). There occur also a few small plants of the radiant type and some grasses (*Diodia teres*, *Sesuvium*, *Syntherisma fimbriatum*, *S. filiformis*, *Cenchrus incertus*, *C. tribuloides*, *Euphorbia cordifolia*). *Physalis angustifolia* is also frequently met with.

The second type of sand plain referred to above may be designated as the open, grass plain, characterized as it is by a plant covering of a large number of herbaceous species of low stature among which the grasses greatly predominate. Some of the grasses, however, are of large size, *Chaetochloa magna* and *Uniola paniculata* for example. The other prominent feature is effected by a heavy growth of slender vines (*Vigna glabra*, *Clitoria mariana*), sometimes so dense as to cover the other vegetation out of sight, and covering considerable area. On the whole the conditions in this type of sand plain are decidedly mesophytic as compared with the beaches and other formations here described, because of the dense covering of plants and because also of the much less salt content of the soil. Two species of *Commelina*, *Chamaecrista littoralis*, *Gerardia purpurea*, *Croton maritimum* and a goodly number of low mesophytes complete the association.

The third type of sand plain is the forest-covered area to be found only on the larger islands of the Mississippi Sound, where a large area has been for a long period of time removed from the immediate influence of the sea. Regarding Cat Island as a type, the plain may be described as established, inasmuch as the surface is subject to erosive agencies only to a very slight degree. There are no water courses, unless one would attach that name to sloughs in which the water is practically at a standstill. The wind can have but little effect upon the topography, as the soil is moist and moreover is protected by the tree covering, while the force of the wind is broken by the large dunes lying to the windward. The surface is level save for a few low sand mounds which are not improbably to be regarded as fossil dunes, whose topography is at present beyond the influence of erosive or moving agents. Elsewhere the surface is lowered a little and the soil becomes much wetter. Broadly speaking the whole area is covered by a forest of pines of two species, *Pinus australis* and *P. Taeda*, with *Sabal glabra* and *Serenoa serrulata* as prominent elements in the undergrowth. In the wetter places under the shade of the palmetto last named, a hepatic (*Pellia* sp.) was found in abundance in August, and there is reason to believe that in the winter season a number of species would be met with. In general, one may say that the pine-covered plain is ecologically a part of the coastal plain of the mainland, and that the flora differs from that of the pine barrens of the coastal plain in scarcely anything except in the number of species. So, too, with the mounds or fossil dunes above referred to upon which one finds invariably a growth of live oaks, generally *Quercus geminata*, or less frequently *Q. Virginiana*, under the shade of which, and in a soil of much greater organic content, grow a group of plants commonly found on the mainland in like situations. The tree trunks are clothed with incrusting lichens, while from the branches grow *Ramalina* and some foliaceous species. On the lower parts of the trunks, and on the ground, mosses (*Leucobryum* especially) and liverworts grow. The lichen *Cladonia rangiferina* in rich fruiting condition was also found growing in clumps on the ground. Beyond the shade of the trees, on the slope of the mound *Opuntia Pes-corvi* and *Baldwinia multiflora* are to be found together with a little convolvulus, *Breweria*, forming, however, a scanty plant covering only. Attention should be drawn to the fact that the epiphytic plants (*Polypodium polypodioides* and *Tillandsia usneoides*) which are so common on the live-oaks of the nearby mainland, are here entirely absent.

Sand Dune Formation

In addition to the dunes already described in connection with the sand beach and sand plain formations there are two other dune types which still remain to be mentioned. These are the established dunes of low stature and the high wandering dunes.

The former occur notably on Breton Island, and are usually less than one meter in height. They are clothed with a thicket of *Ilex vomitoria* and *Myrica Gale*, and with these is an undergrowth of herbaceous plants such as have been referred to in the description of the open grassy sand plain, of which in point of fact, this *Ilex-Myrica* dune formation is a part which has changed its aspect as a consequence of the growth of those evergreens. The cause of this change is obscure, but it seems probable that the shrubs have been better able to establish themselves on the lee of the grass plain. The formation corresponds very closely to the thicket formation of Ocracoke described by Kearney, but lacks the particular species mentioned by him. Owing to the rather heavy protective covering of shrubby vegetation these low dunes are not affected by the wind to an appreciable extent and may therefore be regarded as in a relatively static condition, or otherwise expressed, as established.

Only one of the islands visited affords conditions favorable for the formation of the high, wandering dunes, namely Cat Island, where they are to be found on the windward side. They are arranged in a linear system which lies parallel with the shore line, and range in height from ten to twenty meters. The most northerly dune of the system is the highest, and constitutes on this account a prominent landmark. It is quite naked save on the lee slope where a few annuals, *e. g.*, *Jatropa stimulosa*, *Cenchrus* sp. and some others, gain a temporary foothold in the shade of the trees which are doomed to partial or complete burial. The only relation which this dune in particular holds to the vegetation is that of a destructive agent, for the pines especially are not able to withstand the burial in sand. The live-oaks are, however, more resistant, and many examples of trees may be seen with only the ends of their branches protruding above the sand, and having the appearance of vigorous shrubbery. The branches of these oaks are covered with a growth of crustaceous lichens and a species of *Ramalina*, while an occasional annual grows in their shade upon the dune surface.

The other dunes of the series have on their windward slopes a vegetation of annuals and perennials composed chiefly of *Iva imbricata* and *Serenoa serrulata*, with occasional clumps of *Uniola paniculata*, *Siphonychia corymbosa* and species of *Euphorbia*, plants which are by no means confined to this habitat, as the reader has already seen. The lee slope, which in all cases observed is very steep, recalling the appearance of the dunes of Figs. 15 and 16 of Cowles' paper supports no plants excepting a meagre, but never too meagre, growth of *Cenchrus*. These dunes are in rapid motion, and have left behind them a "graveyard" of dead pines. Their motion is evidenced not only by the character of the lee slope but also by the distorted, protruding, but still living leaves of engulfed plants of *Serenoa*. Reference has been made to the low sand mounds encountered in the pine-clad plain as having originated as dunes, but which are now beyond the effect of the winds. Upon this explanation they may be called fossil dunes in a somewhat exact sense.

SHELL STRAND VEGETATION (PLATE 11)

In the general account of the physiographic features of the islands attention was drawn to the origin and presence of a dune of shells on the seaward margin of many of the low islands. There are two ways in which the dune may lie with reference to the margin of the alluvial plain upon which it is superposed. The figures here presented will show at a glance the difference. In the upper diagram (Fig. 2, *a*) the edge of the alluvium is bare, so that it is eroded by the waves, and *pari passu* the shell dune is advanced toward the lee edge of the island. Under some conditions the edge is eroded more rapidly than the shell dune is moved forward.

Or it may be also that the load of shells has not been lifted well upon the muck plain, so that in either case the seaward margin of the dune lies below the water level. In this way a shell beach is formed, such as is represented in the lower figure. A description of the latter condition will serve for the present purpose because, as will be shown, the flora of the two differs but little.

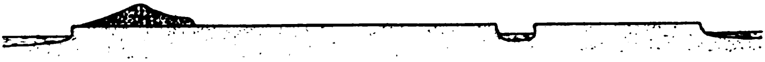

FIG. 2*a*. Diagram of a shell-marsh island at right angles to the shell dune.

The conditions of growth on a shell dune are as follows: Organic materials, as well as alluvial detritus are almost entirely absent as they are carried through by the percolating water, which at the same time reduces the salinity if the substratum. The degree of salinity may, however, be suddenly increased by the sea water in unusual weather. This absence of salinity is not true of the lower beach, which, however, is devoid of vegetation for other reasons. Water of capillarity is absent except rarely when the fragments are very small. A fair amount of moisture is, however, present because the shell fragments hold water better than might be suspected. These characters, taken together with the high temperature and intense insolation, produce a decidedly xerophytic condition. The percolating water contains probably an unusual amount of calcium carbonate, making the shell dune not unlike a coral beach.

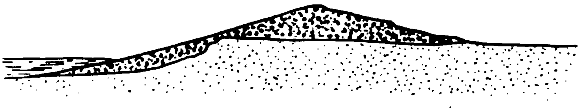

FIG. 2*b*.

In spite of such apparently unfavorable conditions, the small area of the shell dune produces a good number of plants.

Vegetation is not encountered in the lower beach or the lower zone of the middle beach. The plants of the upper zone of the middle beach are chiefly prostrate annuals, of which *Euphorbia polygonifolia* and *Strophostyles* are almost the only examples.

Chenopodium Berlandieri sometimes occurs. It is possible to point out the limit of the middle beach only in a loose way. For the present we regard the upper beach as occupying the ridge and the area behind it. Here the flora is very diversified. *Iva frutescens* is the first shrub to make its appearance, and this almost always heavily attacked by *Cuscuta Gronovii.* In lower places *Spartina polystachya* and *S. junciformis* and *Sporobolus Virginicus* are quite abundant. On the crests of the ridges *Dondia maritima* and *Atriplex cristata*, while here and further back *Lycium Carolinianum*, *Borrichia frutescens*, *Chrysoma pauciflosculosa*, and *Opuntia Opuntia* are the chief perennials. Among these *Ambrosia artemisaefolia*, *Leptilon Canadense*, *Lepidium Virginicum*, *Elymus Virginicus*, *Polygonum* and *Cakile fusiformis* form a weedy growth. Creeping over these plants are the vines *Seutera palustris*, *Vigna glabra* and *Ipomoea sagittata* and *I. commutata.*

SALT MARSH VEGETATION

Muck Marsh Formation (*Plate 11*)

The simplest salt marsh condition is to be found on those islands which are small and lie in a protected position so that the sea does not throw up the shell fragments which occur in the contiguous waters. An island of such character is a low-lying, alluvial flat with a surface which is nearly level. The flora is limited to a few species segregated usually in two easily recognizable associations. These are the grass association, either mixed or pure, and the *Batis-Salicornia* association. The former is to be found more often near the shore where the surface is a little higher than in the interior and is composed of *Spartina* (*S. patens* and *S. stricta*), which in many places are largely replaced by *Distichlis.* Other grasses are quite rare. The other association is composed of succulents of two genera, namely, *Batis maritima* of tropical and subtropical distribution, *Salicornia Bigelovii* and *S. ambigua.* The first-named is by far the most dominant plant, forming in some places a pure association covering acres of surface. A striking character of the plant is the strong development of cortical aërenchyma about the roots and the lower part of the stem. The anatomical characters of this and many others of the American tropical strand succulents have been described by Warming. The salicornias, which are plants of more northern distribution, are by no means so plentiful as *Batis*. They are, however, of the same ecological character, being stem succulents, while *Batis* is a leaf succulent. The only other plant occurring in the muck marshes is *Avicennia nitida*, with its well-known negatively geotropic roots (pneumathodes). This mangrove grows abundantly on some of the islands to the extent almost of the exclusion of other species (Breton Island), but in no case reaches a height greater than 60 cm. They produce, however, flowers and fruit. On some of the islands visited great numbers of dead plants were found which had doubtless been killed by the frost. The fact that all the dead ones were about of a size indicates that this plant is so killed and that it is here in its northern limit. The soil of the salt marsh is composed of a very finely-divided alluvium which packs very tightly, and this with the water which is saline results in a mass which effectually prevents the entrance of air. This accounts for the development of the pneumathodes of *Avicennia* and the abundant aërenchyma of *Batis*, paralleling the well-known structures of similar adaptive significance in many swamp plants.

The general appearance of the salt muck marsh vegetation is one of somber uniformity. The succulents are of the same height and color—a dark green, and the grass association is a bluish gray. The variety of color of the northern salt marsh plant covering is well-nigh absent.

From the above it will be seen that there are scarcely any plants common to the shell strand and muck marsh. Apparent exceptions (*e. g.*, *Spartina juncformis*) may usually be explained by the fact that the roots may penetrate into the mud through the shells. Marsh plants may thus be found in the shell strand, especially in the shell-muck marsh. The converse is scarcely ever true. The lee edge of the encroaching shell dune shows a sudden and complete change from the muck marsh, as is shown in Plate 4.

Shell Marsh Formation

In some instances the shell dune becomes broad and scattered on the inner limit and the shell fragments are mixed with the alluvium of the marsh so as to make a looser soil which is less homogeneous and better aërated. It happens also that the area may be better drained. In such conditions the plants are prostrate (*Lippia nodiflora*, *Lithophila vermiculata*) with the exception of *Salicornia*, one species of which has plagiotropous shoots. With these there was found on Bird Island a single plant of *Citrullus vulgaris*, a plant mentioned also by Kearney as occurring in a feral state on Ocracoke. *Limonium Nashii* grows usually in such a soil, and is to be found for the most part on the lee margin of the shell dune.

Sand Marsh Formation

On the larger islands the sand covering of the lee part of the island is sometimes so thin that the alluvial foundation is hidden by only a few centimeters. In limited areas, however, the depth of the sand may be greater. In these two ways the conditions for a sand marsh are set up in which the plants may be rooted in pure sand or partly in the underlying alluvium. The latter condition is especially favorable for the formation of a reed marsh in which species of *Juncus* are the chief factors. Marshes of this kind are sometimes of large area. When the sand covering is very thin, as is the case in parts of Breton Island, the sand marsh takes something of the character of the muck marsh, and *Batis* and *Salicornia* may occur. When the depth of sand is greater, which happens more frequently at a point more remote from the influence of the salt water an association of plants grows up in which *Xyris serotina*, *Utricularia subulata* and *Oldenlandia uniflora* are prominent members. The more shoreward stretches of wet sand are either naked or bear a sparse growth of small plants. Among the number are *Siphonychia corymbosa*, *Polypremum procumbens*, *Gratiola subulata* and *Diodia Virginiana*.

THE MUD LUMPS

The top soil of these islands is very thin, overlying a dense, sticky clay. The usual marsh and aquatic plants are almost wholly wanting, as are also pines and oaks. The more abundant grasses are *Spartina stricta* and *Capriola Dactylon*. The only large trees are melias which have doubtless been introduced. On one of these islands a dense growth of a trailing *Rubus* not observed elsewhere covered many acres. Tamariscinas and other Amaranthaceae are much more abundant here than on the sand islands. *Baccharis halimifolia* is abundant on all the mud lumps and is often the only woody plant.

THE DELTA

No attempt has been made in the preceding pages to include a treatment of the phytogeographical conditions of the land of the Delta, since it is a part of a region which justly requires a separate study. The general statements pertaining to the more recent part of that area are as follows.

The "passes" of the Mississippi River are broad channels of fresh water separated from the waters of the Gulf by an irregular and frequently very narrow strip of land of river deposit. The greatest elevation of the surface above sea level is on the bank of and near to the stream. On the other side the land slopes gradually away toward salt water, while toward the fresh water the slope is abrupt.

Two associations are to be recognized, both of which have grasses as the determining elements. These are the *Phragmites, Vigna* and the *Spartina* associations. The former occupies the higher levels and therefore the portion of the bank near the fresh water. The grass makes a dense growth, and spreads by means of the long decumbent stems and stolons. These and the roots bind the soil, which however is gradually eroded, leaving projecting clumps of the grass along the banks. From these clumps the decumbent or prostrate stems project out into the water and sway in the current, extending down stream 30 meters or more. On the highest part of the bank the "canes" form a mechanical support for a very profuse growth of *Vigna glabra* which is almost impenetrable. Occasional trees of *Salix nigra* and vines of *Ampelopsis arborea* are to be seen along the bank.

In the swampy ground of the lower levels which border on the salt water *Spartina* gives the character to the vegetation, and this is often the sole plant. The two associations fade into each other, but there is nevertheless a fairly distinct line of demarkation. As one advances northward and as the land broadens out, a sort of swamp meadow land is found, where occur many grasses and leguminous plants. Here, too, the willows become more numerous and the cypress comes in.

BALLAST

At the lower end of the south pass there occur a number of plants which are adventive from many parts of the world. These have been brought in ballast which has been dumped along the banks near Port Eads where these exotic forms are to be found in considerable profusion. A few have already become established and probably others will be established in the future. The ballast plants are chiefly tropical and subtropical in their origin.

PHYTOGEOGRAPHY

The general geographical relations of the Delta island flora may now be indicated briefly.

We notice with Kearney the infrequency of parasitic fungi, and it seems probable that his explanation is correct, namely that the adaptations which serve to inhibit transpiration enable plants to resist the attacks of parasites. Other fungi are also scarce. A very few boleti and polypori were collected.

The algal flora has already received mention. It may be added that a certain species of green alga occurs in quantity on the surface of the muck marshes, and attached to the lower parts of the stems of *Spartina* and other muck marsh plants. Otherwise the algal flora is very meagre.

Lichens are abundant on the limbs of trees (oaks and myricas) and sometimes on the ground on the larger islands.

Mosses are rare excepting in a few favored localities on the larger islands.

Liverworts are rather more abundant but are not striking in quantity or number of species. Some *Lejeunea* forms occur indicating a general tropical character of the hepatic flora.

Certain widely distributed ferns occur, and these will be mentioned in the list. They do not, however, form more than a weak element in the plant covering of the larger islands.

Regarding the spermatophyta we may make the following provisional statements :

1. Extended sand plains, removed from the direct influence of

salt water, make possible the growth of a large number of plants characteristic of the austro-riparian. These plains present the appearance of the typical pine barrens, with the absence of magnolias and deciduous oaks. The trees are *Pinus Taeda*, *P. palustris*, *Quercus geminata* and, less frequently, *Q. Virginiana*. As woody undergrowth *Sabal glabra*, *Serenoa serrulata* and a large congeries of herbaceous plants common to the austroriparian. In this regard the larger of the Delta islands stand in contrast with Ocracoke. A few of the genera may be mentioned as indicating the type of vegetation: *Aristida*, *Ascyrum*, *Andropogon*, *Drosera*, *Helianthemum*, *Gerardia*, *Hypericum*, *Lacinaria*, *Lechea*, *Opuntia*, *Panicum*, *Polygala*, *Rhexia*, *Sabbatia*, *Willughbaea*.

2. Certain plants are distributed far to the north and are found as strand plants.

**Baptisia leucantha.*
Cenchrus tribuloides.
**Eclipta alba.*
Euphorbia polygonifolia.
Monarda punctata.
Rhus copallina.
Ruppia maritima (in saline waters).
**Smilax Bona-nox.*
Strophostyles helvola.
Triglochin striata (Maryland).
Triplasis (*Sieglingia*) *purpurea.*
Vitis aestivalis.

Moseley has shown that the appearance of a certain number of plants of southern distribution in the region of Sandusky Bay, Lake Erie, is due to the higher temperature and longer growing season. A mean difference of nearly 5° F. as compared with the climate of Buffalo is noticed. Those plants marked thus * in the above list occur also at Sandusky Bay.

The following are found in North America only on the Atlantic coast as far north as indicated.

Baccharis halimifolia (Mass.).
Borrichia frutescens (Va.).
Croton maritimus (N. C.).
Distichlis spicata (Nova Scotia).
Gerardia maritima (Me.).
Ilex vomitoria (N. C.; Va.?).
Iva frutescens (Mass.).
Juncus scirpoides (N. Y.).
Kosteletskya Virginica (N. Y.).
Xanthoxylum Clava-Herculis (N. C.; Va.?).

Lippia nodiflora (Ocracoke Island, N. C.).
Opuntia Pes-corvi (N. C.).
Panicum amarum (changing to var. *minus* in its northern range).
Pluchea camphorata (Mass.; West Indies).
Salicornia ambigua (Mass.).
Salicornia Bigelovii (Nova Scotia).
Seutera (*Vincetoxicum*) *palustre*.
? *Solidago sempervirens* (New Brunswick).
Spatina patens (Newfoundland).
Spartina polystachya (Me.).
Yucca gloriosa (Ocracoke Island, N. C.).

4. Strand plants of tropical or subtropical distribution.

(*a*) Tropical plants of the New World:

Batis maritima.
Canavalia obtusaefolia.
Centella Asiatica.
Chrysoma pauciflosculosa.
Iva imbricata.
Lippia nodiflora.
Sabal glabra.
Serenoa serrulata.
Uniola paniculata (Virginia, West India, and South America).

(*b*) Tropical plants, circumterrestrial, or occurring at least in the Old and New World:

Avicennia nitida.
Ipomoea acetosaefolia.
Ipomoea Pes-caprae.
Lithophila (*Philoxerus*) *vermicularis.*
Sesuvium portulacastrum.

5. A few plants of very wide distribution occur as weeds, especially in the shell dune formation. The following are the principal ones:

Ambrosia artimisaefolia.
Lepidium Virginicum.
Leptilon Canadensis.

LIST OF SPECIES*

In the preparation of this list we have followed, as closely as possible, the nomenclature given in Britton and Brown's Flora of North America, the family sequence being that of Engler and Prantl, while the genera and species are arranged alphabetically. In addition to the species actually collected on this trip we have added several which have been collected previously by one of the authors (S. M. T.) on the same islands. The algae, some fungi and bryophytes collected have not yet been studied and therefore do not appear. We are indebted to Dr. N. L. Britton, Dr. J. K. Small, Mr. G. V. Nash, Dr. E. L. Greene, Dr. C. F. Millspaugh, Prof. F. Lamson-Scribner and Prof. F. S. Earle for the identification of numerous specimens.

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* Plants reported by Kearney (6) as occurring on Ocracoke Island marked *. Those occurring in the strand flora of New Jersey, reported by Harshberger (4) thus †.

Cercospora sp. On *Ipomoea acetosaefolia*, Breton Island.

Puccinia paspali T. & E. On *Paspalum Vaseyanum*, Port Eads.

Uromyces euphorbiae C. & P. On *Euphorbia prostrata*, Cat Island.

U. polygoni (Pers.) Fckl. On *Polygonum littorale*, Ile à Pitre.

OSMUNDACEAE

† *Osmunda regalis* L. Occasional on Cat and Breton Islands.

POLYPODIACEAE

Pteris aquilina caudata (L.) Hook. Cat and Breton Islands.

SALVINIACEAE

Azolla Caroliniana Willd. In quiet coves, mud lumps, near Passa Loutre, washed down by the currents. The plant was also collected floating in the stream, with *Lemna* sp.

PINACEAE

* † *Juniperus Virginiana* L. Two old trees on Cat Island, not observed elsewhere.

Pinus palustris Mill, *P. serotina* Michx., *P. Taeda* L. These three pines are abundant on Ship, Cat and other sandy islands, but are never found in black muck or very wet soils.

Taxodium distichum (L.) L. C. Rich. Occasional on Cat Island; the Delta.

TYPHACAE

* † *Typha latifolia* L.

Common in marshy places, even where the water is quite brackish, and one of the characteristic growths along the river banks. Almost the first species to take possession of the newly formed land about the jetties.

NAIADACEAE

† *Ruppia maritima* L. Common in brackish ponds.

SCHEUCHZERIACEAE

* *Triglochin striata* R. & P. Common in mouths of bayous on the larger islands.

ALISMACEAE

Sagittaria graminea cycloptera J. G. Smith. Ship Island, on margin of pond.

S. lancifolia L. On marshy ground, South Pass.

GRAMINEAE

Andropogon Elliottii Chapm. Occasional on dry knolls on the larger islands.

A. glomeratus Walt. Rather common on margins of ponds on sandy islands.

A. maritimus Chapm. Common on drifting sands only. Florida to Mississippi on the coast.

†*A. Virginicus* L. Occasional on Cat and Breton Islands.

Aristida dichotoma Michx. Ship and Cat Islands.

A. gracilis Ell. In one locality on Cat Island.

A. lanata Poir. Occasional in dry woods, Cat Island.

†*A. purpurascens* Poir. On dry sandy soil, somewhat remote from the beach on Cat Island.

A. spiciformis Ell. On sandy marsh, Ship Island.

**Capriola Dactylon* (L.) Kuntze. Abundant everywhere except on the muck marshes and high dunes, very abundant on the mud lumps. Introduced.

Cenchrus incertus M. A. Curtis. Abundant on sandy soils, and the most common species of the genus. A pine barren grass. Southern Jersey southward.

C. megacephalus Doell. Abundant just above the tide line on all sandy beaches, but not found elsewhere.

†*C. tribuloides* L. Common on sandy islands.

**Chloris petraea* Sw. Common in the interior of all sandy islands.

†*Diplachne fascicularis* (Lam.) Beauv. On low, wet sandy barrens, Ship and Cat Islands.

* †*Distichlis spicata* (L.) Greene. Abundant on damp soils, especially on the muck marsh islands.

Elymus Virginicus L. (?) Occasional on shell beaches, Ile à Pitre and Sam Holmes Islands.

Eragrostis hirsuta (Michx.) Nash. In a single locality, Breton Islands. Perennial.

**E. Elliottii* S. Wats. Occasional on dry sand.

E. pectinacea (Michx.) Steud. Common except on muck soils.

E. secundiflora Presl. Rather common on the drier soils of Ship, Cat and Breton Islands, many of the panicles of the plants on Breton Island being strongly viviparous, a peculiarity not found elsewhere. Confined to the gulf coast.

Erianthus saccharoides Michx. Cat and Breton Islands.

Chaetochloa corrugata parviflora (Poir.) Scribn. & Mer. Port Eads.

C. glauca (L.) Scribn. Port Eads.

C. gracilis (H.B.K.) Scribn. & Mer. Common on ballast ground, Port Eads.

* †*C. imberbis* (Poir.) Scribn. Ile à Pitre and Cat Island, on sandy beaches.

C. magna (Griseb.) Scribn. Abundant on low wet black soil on Breton Island, occasional on Bird and Battledore Islands.

* †*Panicum amarum* Ell. Very abundant on Battledore, Breton and other southern islands, but rare near the Mississippi and Louisiana coasts.

P. angustifolium Ell. Occasional on Cat and Breton Islands.

P. colonum L. Ship and Cat Islands.

†*P. Crus-galli* L. Occasional on margins of ponds on the larger islands and very abundant in the marshes along the river.

P. depauperatum Muhl. Occasional on Breton Island.

P. gibbum Ell. In one locality on Cat Island. Coastal plain from southeast Virginia to Florida, and westward to Texas and Cuba.

Panicum halophilum Nash

P. repens L. var. *confertum* Vasey, not *P. confertum* Desv. 1816.

A smooth and glabrous perennial with a long, stout rootstock from which arise rather stout erect stems which are densely clothed toward the base with overlapping leaves. Stems 1.5–4 dm. tall; leaves crowded below, scattered or wanting above; sheaths with the margin often ciliate; ligule a narrow scarious ring less than 0.5 mm. wide; blades firm, flat, lanceolate, usually 2–6 cm. long, sometimes longer, 3–8 mm. wide; panicle dense, 2–9 cm. long, its branches ascending; spikelets crowded, glabrous, about 2.5 mm. long and a little over 1 mm. wide, the first scale one half as long as the spikelet, or nearly so, the apex acute at a broad angle, apiculate.

In sand along the seashore acting as a sand-binder, Mississippi. Also in Mexico. Collected on Petit Bois Island, Mississippi, by S. M. Tracy, on May 8, 1898, no. 4566, and distributed as *P. repens confertum*. While resembling *P. repens* in general habit, its smaller dense panicle and the larger acute first scale of the spikelet will at once distinguish it. In *P. repens* the panicle is long and slender, and the first scale of the spikelet is only about a fourth as long as the spikelet and truncate at the apex.

Very common on beaches and damp, sandy places on all the islands, the horizontal creeping rootstocks often three metres in length and rarely producing tubers.

P. hians Ell. Common in wet, sandy places.

P. Nashianum Scribn. Dry, sandy banks, Cat Island. Common on dry sandy places, usually in the shade of palmettoes or other shrubs. Pine barrens.

†*P. proliferum* Lam. Observed only near an old house at South Pass. A straw grass.

P. repens L. Occasional on the dunes and dry sand ridges of Ship and Cat Islands, the abundant tubers on the perpendicular rootstocks often buried to a depth of eight decimetres.

P. sphaerocarpon Ell. Cat and Breton Islands.

P. Walteri Pursh. In wet, sandy places, Breton Island.

**Paspalum ciliatifolium* Michx. Common on the larger islands.

P. compressum Nees. Occasional on the larger islands, abundant on the mud lumps, and at Port Eads.

P. Curtissianum Steud. Cat Island.

**P. distichum* L. On wet, black, heavy soil on several islands; very abundant at South Pass and along the jetties.

P. Floridanum Michx. Cat Island.

P. membranaceum Walt. On margins of ponds, Ship and Cat Islands.

P. paspaloides (Michx.) Scribn. One locality on Ship Island.

P. plicatulum Michx. Abundant on rich, damp soil, Ship, Cat and Breton Islands.

P. setaceum Michx. Common on the larger islands.

P. Vaseyanum Scribn. Port Eads. Has been found by one of the writers (S. M. T.) at New Orleans and Mobile, but not elsewhere along the coast.

Phragmites Phragmites (L.) Karst. Occasional on wet soil on nearly all of the islands, and the most common species on the low mud flats, from Cubit's Gap to the mouth of the river, often growing in the edge of the water and producing floating, proliferous canes from five to eight metres in length. The predominant species on the low, newly-formed land near the jetties.

Spartina junciformis Engelm. & Gray. Entirely confined to the Gulf coast.

* † *S. patens* (Ait.) Muhl., † *S. polystachya* (Michx.) Ell., * † ? *S. stricta* (Ait.) Roth. All of these species were found very abundantly on nearly or quite every island and locality visited, *S. patens* and *stricta* being the more common species in the interior of the islands, while the others are confined principally to within a few meters of the beach.

* *Sporobolus Indicus* (L.) R. Br. Rare on the larger islands; abundant on made ground, from South Pass to Port Eads.

S. junceus (Michx.) Kunth. Not rare on dry knolls, Cat and Breton Islands.

S. Virginicus (L.) Kunth. On sandy beaches just above tide, often forming a dense sod-like growth.

Stenotaphrum secundatum (Walt.) Kuntze. Occasional on Breton Island and at South Pass.

S. filiforme (L.) Nash. Abundant on Cat Island, spikes often 3 dm. in length.

Syntherisma fimbriatum (Link) Nash. On dry beaches, Cat Island.

S. humifusum (Pers.) Rydb. Somewhat common on dry soil, Cat and Breton Islands.

S. sanguinale (L.) Nash. Common everywhere except on muck marshes.

Triplasis Americana Beauv. Occasional on dry, sandy soil in pine woods, Cat Island.

T. purpurea (Walt.) Chapm. On dry, sandy knolls, Cat, Hog, Battledore and Ship Islands.

Uniola longifolia Scribn. Occasional in moist woods, Cat Island.

**U. paniculata* L. Very abundant on Ship, Cat and Breton Islands, the larger lumps sometimes producing as many as sixty culms, and forming a striking feature of the dry and almost naked sand hills.

CYPERACEAE

**Cladium effusum* Torr. On borders of ponds, Ship, Cat and Breton Islands; common at South Pass and Port Eads.

Cyperus articulatus L. One locality on a dry, sandy beach, Cat Island.

*?†*C. cylindricus* (Ell.) Britton. Larger heads and broader leaves than those of the eastern type. Common on Ship and Cat Islands; occasional on Breton Island and at Port Eads.

C. erythrorhizos Muhl. Breton Island.

C. ferox Vahl. Cat and Breton Islands, not common.

C. flavus (L.) Boeckl. On ballast ground, Port Eads.

C. Haspan L. On wet, sandy soil, Ship and Cat Islands.

C. inflexus Muhl. South Pass.

C. Lecontei Torr. Common on damp, sandy soil on the larger islands; the rootstocks often two or three metres in length.

C. lutescens Torr. & Hook. Port Eads; Battledore Island.

C. microdontus Torr. Sand, Breton Island. Not common.

C. polystachyus Rottb. Widely distributed in tropical regions. On ballast ground, Port Eads. The Torrey Herbarium contains a specimen of this collected in New Orleans many years ago, probably about 1820, and one from St. Augustine, Fla., 1876, A. P. Garber.

C. prolixus H.B.K. In flower only; unknown hitherto in North America; ballast, Port Eads.

C. Surinamensis Rottb. On ballast ground, Port Eads. Doubtless adventive from the Caribbean region.

C. vegetus Willd. In wet meadow, South Pass.

C. virens Michx. In one locality at South Pass and on Breton Island.

**Dichromena colorata* (L.) A. S. Hitchcock. Rather common on the wet, sandy soils of the larger islands; not observed on the mainland, where it is replaced by *D. latifolia* Baldw.

* ?*Eleocharis albida* Torr. In a wet meadow, South Pass.

Fimbristylis autumnalis (L.) R. & S. Common.

†*F. castanea* (Michx.) Vahl. Common.

F. laxa Vahl. Ship Island and Port Eads.

**F. spadicea* (L.) Vahl. Breton and Cat Islands.

F. Vahlii (Lam.) Link. Common at South Pass.

Hemicarpa micrantha (Wahl.) Britton. Wet sand on Ship Island and river bank at South Pass.

Kyllingia brevifolia Rottb. In a wet meadow, South Pass.

Rynchospora dodecandra Baldw. On a sandy knoll in shade of oak trees, Cat Island.

R. fascicularis (Michx.) Vahl. Occasional on Cat Island.

* †*Scirpus Americanus* Pers. Breton Island and South Pass.

†*S. robustus* Pursh. On mud lumps.

Scleria triglomerata Michx. Cat Island.

Stenophyllus Stenophyllus (Ell.) Britton. On river bank at South Pass.

SABALACEAE

Sabal glabra (Mill.) Sarg. Occasional on Cat Island.

Serenoa serrulata Benth. & Hook. Abundant on the drier parts of the sandy islands.

LEMNACEAE

Lemna sp. In bays, brackish water, mud lumps.

XYRIDACEAE

Xyris serotina Chapm. On border of marsh, Cat Island.

COMMELINACEAE

Commelina nudiflora L. Cat and Breton Islands.

C. Virginica L. Breton Island.

PONTEDERIACEAE

Pontederia cordata L. Abundant along the river from Cubit's Gap to Port Eads.

JUNCACEAE

†*Juncus marginatus biflorus* Wood. Common on Ship and Cat Islands.

* †*J. scirpoides* Lam. Ship, Cat and Breton Islands.

LILIACEAE

**Yucca gloriosa* L. Abundant on sand hills, Breton Island.

SMILACEAE

Smilax auriculata Walt. Breton Island.

**S. Bona-nox* L. Common on dry, sandy beaches above tide line.

MYRICACEAE

* †*Myrica cerifera* L. Common on all islands producing shrubs, often forming dense thickets on the borders of marshes, Ile à Pitre, Cat and Breton Islands.

SALICACEA

Populus deltoides Marsh. Occasional on newly-made ground from South Pass to the jetties.

Salix nigra Marsh. Very abundant from South Pass to the jetties. The wood of this species is used almost exclusively in making the mattresses to form the jetties and the young trees are among the first to take possession of the newly-formed banks.

FAGACEAE

Quercus geminata Small. The common oak of Ship and Cat Islands.

**Q. Virginiana* Mill. Occasional on the islands, and the common form on the mainland.

MORACEAE

Toxylon pomiferum Raf. A single tree on ballast ground, Port Eads.

POLYGONACEAE

Polygonella gracilis Meisn. Occasional on sandy knolls, Ship and Cat Islands.

Polygonum littorale Link. On shell beaches, Ile à Pitre and Battledore Island.

P. Opelousanum Ridd. Ship and Cat Islands.

P. punctatum robustior Small. In wet meadows, South Pass.

* *? Rumex verticillatus* L. On mud lumps.

CHENOPODIACEAE

Atriplex cristata H.B.K. On mud lumps and Breton Island.

**Chenopodium anthelminticum* L. On ballast grounds, Port Eads.

C. Berlandieri Moq. Common on sandy beaches.

†*Dondia linearis* (Ell.) Heller. Common on low, barren sand spits, Breton, Bird and Battledore Islands.

†*Salicornia ambigua* Michx.

†*S. Bigelovii* Torr.

Common on all saline marshes, and often forming the bulk of the vegetation over extensive areas. Both of the species are also found occasionally on wet and rather barren sand just above tide level.

* †*Salsola Kali* L. Sand beaches and plains, Breton and Bird Islands.

AMARANTHACEAE

Alternanthera philoxeroides Griseb. On ballast ground, Port Eads.

Amaranthus spinosus L. Occasional near an old house, Cat Island.

Froelichia Floridana Moq. On dry, sandy knolls, Ship, Cat and Breton Islands.

Lithophila vermicularis (*lata*) (L.) Uline. A few plants on shell marsh, Bird Island.

Tamariscina concatenata (Moq.) Uline & Bray. Breton Island and mud lumps.

T. tuberculata (Moq.) Uline & Bray. Battledore and Breton Islands.

BATIDACEAE

Batis maritima L. In all muck marshes or in those with a thin covering of sand.

AIZOACEAE

**Mollugo verticillata* L. Abundant on dry sand, Cat Island.

Sesuvium portulacastrum L. Rather common on damp sand or shell beaches.

CARYOPHYLLACEAE

Scleranthus annuus L. Occasional on sandy islands.

Siphonychia corymbosa Small. Occasional on Ship Island, which is the type locality, and abundant on Cat Island.

Stipulacida setacea Michx. Cat and Breton Islands.

NYMPHAEACEAE

Castalia tuberosa (Paine) Greene. In pond on Cat Island.

MENISPERMACEAE

Cebatha Carolina (L.) Britton. Occasional on Cat and Breton Islands.

LAURACEAE

Persea pubescens (Pursh) Sarg. Cat Island.

PAPAVERACEAE

Argemone Mexicana L. A few plants on ballast ground, Port Eads.

CRUCIFERAE

Cakile fusiformis Greene. On sand and shell beaches, Bird, Battledore and Breton Islands.

Lepidium Virginicum L. Battledore and Sam Holmes Islands.

DROSERACEAE

Drosera rotundifolia L. Wet sand, Cat Island.

ROSACEAE

**Rubus trivialis* Michx. Cat and Breton Islands.

Rubus sp. An unidentified species belonging to the *trivialis* group is very abundant on one of the larger mud lumps, where it makes a growth so rank and dense as to be almost impenetrable.

MIMOSACEAE

Acuan brachyloba (Benth.) Kuntze. In field at South Pass.

A. Illinoensis (Michx.) Kuntze. On shell beach, Ile à Pitre.

Mimosa strigillosa T. & G. Common at South Pass.

CAESALPINACEAE

Chamaecrista sp. Very abundant on low, damp, sandy soil on Breton Island.

Chamaecrista robusta Pollard. A few plants on dry situations on Cat Island.

PAPILIONACEAE

**Aeschynomene Virginica* (L.) B.S.P. Occasional on Cat Island, abundant at South Pass.

A. viscidula Michx. Ship and Cat Islands, on dry beaches.

Amorpha fruticosa L. South Pass and Port Eads.

Baptisia leucantha T. & G. A few plants on Cat Island.

Bradburya Virginiana (L.) Kuntze. Common on Breton and Cat Islands. A form with almost linear leaflets (var. *angustifolia*) at South Pass.

Canavalia obtusifolia DC. A few plants on Breton Island.

Clitoria Mariana L. Cat and Breton Islands.

Crotalaria ovalis Pursh. Cat Island.

C. rotundifolia (Walt.) Poir. Port Eads.

**Galactia volubilis* (L.) Britton. Abundant except on black, marshy soil.

Indigofera Caroliniana Walt. Occasional on Cat Island and at Port Eads.

Melilotus Indica (L.) All. On ballast ground, Port Eads.

Rhynchosia menispermoides DC. Dry, sandy woods, Cat Island.

Sesban macrocarpa Muhl. Occasional on Cat Island, abundant at Port Eads.

†*Strophostyles helvola* (L.) Britton. Very abundant on all dry, sandy soil excepting on the high dunes.

Stylosanthes biflora (L.) B.S.P. Common on Cat Island.

Trifolium repens L. Occasional along river bank at South Pass.

Vigna glabra Savi. Abundant in nearly every locality visited excepting the low salt marshes and high sand hills, often forming a dense growth covering several acres.

OXALIDACEAE

Oxalis corniculata L. Cat Island.

O. stricta L. Common.

LINACEAE

Linum Floridanum (Planch.) Trelease. Abundant on Breton Island.

RUTACEAE

**Xanthoxylum Clava-Herculis* L. Occasional on Cat Island.

MELIACEAE

Melia Azederach L. The only large trees on the mud lumps.

POLYGALACEAE

Polygala grandiflora L.
P. nana DC. Cat Island; rare.

EUPHORBIACEAE

**Acalpha gracilens* A. Gray. Common on Ship, Cat and Breton Islands.

Croton capitatus Michx. Abundant at Port Eads.

**C. maritimus* Walt. Occasional on Ship and Cat Islands.

C. sp. Cat Island. (L. & T., 205.)

Euphorbia Brasiliensis Lam. On ballast ground, Port Eads.

E. cordifolia Ell. Cat Island.

E. maculata L. Ile à Pitre and Port Eads.

*†*E. polygonifolia* Ell. Cat and Battledore Islands.

E. prostrata Ait. Ship Island.

E. serpens radicans Engelm. Port Eads.

Jatropha stimulosa Michx. Common on Cat Island, in sand, in the shade of trees, especially live-oaks, occasional on Breton.

ANACARDIACEAE

†*Rhus copallina* L. Occasional on Cat Island.

ILICACEAE

**Ilex vomitoria* Ait. Abundant on Ship, Cat and Breton Islands, occasional on Ile à Pitre and Battledore Island.

VITACEAE

Ampelopsis arborea (L.) Rusby. Cat Island and South Pass.

*†*Vitis aestivalis* Michx. Occasional on Cat Island.

MALVACEAE

Hibiscus lasiocarpus Cav. In wet meadows at South Pass.

* †*Kosteletzkya Virginica althaefolia* Shuttlw. Occasional on Breton Island.

Sida rhombifolia L. Common at Port Eads.

S. spinosa L. Cat and Breton Islands.

HYPERICACEAE

Ascyrum cuneifolium Chapm. Cat Island.

Hypericum Drummondii (Grev. & Hook.) T. & G. Cat Island.

Sarothra gentianoides L. Cat and Breton Islands.

CISTACEAE

Helianthemum corymbosum Michx. Abundant on Cat Island.

H. Georgianum Chapm. On a dry, sandy knoll, Cat Island.

Lechea minor L. Ship, Cat and Breton Islands.

**L. villosa* Ell. Common on Cat Island.

TURNERACEAE

Turnera ulmifolia L. On ballast ground, Port Eads.

CACTACEAE

Opuntia Opuntia (L.) Walt. Common on Cat and Breton Islands, and Isle à Pitre.

**O. Pes-corvi* LeConte. Occasional on dry, sandy soil, Cat Island.

ONAGRACEAE

Jussiaea Peruviana L.

J. suffruticosa L. On ballast ground, Port Eads.

**Ludwigia alata* Ell. Margin of pond, Ship Island.

Oenothera laciniata Hill. On ballast ground, Port Eads.

HALORAGIDACEAE

Proserpinaca palustris L. Common on margins of ponds.

UMBELLIFERAE

**Centella Asiatica* (L.) Urban. Abundant on Ship and Cat Islands.

Hydrocotyle Bonariensis Lam. Very abundant and vigorous at Port Eads.

H. sp. Wet sand, Cat Island.

VACCINIACEAE

Vaccinium arboreum Marsh. Occasional on Cat Island.

PRIMULACEAE

†*Anagallis arvensis* L. A single plant, on ballast ground at Port Eads.

* †*Samolus floribundus* H.B.K. Occasional on Cat Island and at South Pass.

PLUMBAGINACEAE

Limonium Nashii Small. Rather common in all saline marshes.

LOGANIACEAE

**Polypremum procumbens* L. Common on the islands in dry soil.

GENTIANACEAE

†*Sabbatia stellaris* Pursh. Abundant on all islands having a sandy soil.

ASCLEPIADACEAE

Asclepias amplexicaulis Michx. Abundant on dry, sandy knolls, Ship, Cat and Breton Islands.

**Seutera palustris* L. Abundant on saline marshes and on sandy beaches.

CONVOLVULACEAE

Breweria sp. Dry knolls, Cat Island.

†*Convolvulus sepium* L. On upper sand beach, Battledore Island.

†*Ipomoea acetosaefolia* R. & S. Common on Breton Island.

I. Carolina (L.) Pursh. Cat and Breton Islands.

I. Pes-caprae (L.) Sweet. Very abundant on dry sand.

**I. sagittata* Cav. Common on damp, sandy beaches.

CUSCUTACEAE

Cuscuta arvensis Beyr. Bird and Cat Islands.

C. Gronovii Willd. Quite common, and usually on *Iva frutescens.*

BORAGINACEAE

Heliotropium Curassavicum L. Occasional in nearly all localities.

H. Indicum L. Breton Island, the mud lumps and Port Eads.

H. inundatum Sw. On ballast ground, Port Eads.

VERBENACEAE

Avicennia nitida Jacq. Rather common from Mitchell Key southward.

Lantana Camara L. Abundant on ballast ground, Port Eads.

**Lippia nodiflora* (L.) Michx. Very common on damp soil.

Verbena littoralis H.B.K. On ballast ground, Port Eads.

V. officinalis L. Port Eads.

V. urticaefolia L. Occasional at South Pass.

LABIATAE

Clinopodium coccineum (Benth.) Kuntze. On dry, sandy knolls, Cat Island.

Lycopus Europaeus L. One locality on beach, Cat Island.

†*Mentha rotundifolia* (L.) Huds. Port Eads.

* †*Monarda punctata* L. A single clump on beach, Cat Island.

* ? *Teucrium* sp. Apparently an undescribed species, related to *T. Nashii.* Occasional on Cat Island.

SOLANACEAE

Lycium Carolinianum Walt. Common on shell beaches, Battledore, Sam Holmes and Sundown Islands.

Physalis angustifolia Walt. Abundant on dry sand, Cat and Breton Islands.

P. mollis cinerascens (Dunal.) A. Gray. On ballast ground, Port Eads.

**P. viscosa* L. On ballast ground, Port Eads. These specimens correspond closely with the true *P. viscosa* from South America, the common North American plant passing under that name probably being a distinct species.

Solanum gracile Link. Occasional on Breton Island.

S. nigrum L. Battledore Island and Port Eads.

S. rostratum Dunal. On ballast ground, Port Eads.

SCROPHULARIACEAE

**Gerardia maritima* Raf. Abundant on Cat and Breton Islands.

Gratiola hispida (Benth.) Pollard. Wet sand, Cat Island.

**Monniera Monniera* (L.) Britton. Cat Island and South Pass.

LENTIBULARIACEAE

Utricularia subulata L. Cat Island.

RUBIACEAE

**Diodia teres* Walt. Common.

* †*D. Virginiana* L. Common.

* ?*Galium hispidulum* Michx. Occasional among bushes on Cat Island.

Houstonia rotundifolia Michx. In rich, damp woods, Cat Island.

Mitchella repens L. Occasional on Cat Island.

**Oldenlandia uniflora* L. Cat Island.

CUCURBITACEAE

**Citrullus vulgaris* Schrad. One plant, Bird Island.

CAPRIFOLIACEAE

Sambucus Canadensis L. South Pass and Port Eads.

COMPOSITAE

Acanthospermum australe (L.) Kuntze. Port Eads.

Actinospermum uniflorum (Nutt.) Barnhart. Occasional on Ile à Pitre.

Aster exilis Ell. Bird Island and Port Eads.

†*Baccharis halimifolia* L. Mud lumps.

Bidens leucantha Willd. Abundant at South Pass and Port Eads.

Baldwinia multiflora Nutt. Dry sand hummocks, Cat Island.

Boltonia diffusa Ell. Cat Island.

**Borrichia frutescens* (L.) DC. Abundant on Breton Island and Ile à Pitre.

Chrysoma pauciflosculosa (Michx.) Greene. On dry sand hills, Cat and Ship Islands.

†*Chrysopsis Mariana* (L.) Nutt. Occasional on Cat Island.

Eclipta alba (L.) Hassk. Common on wet, sandy soil on the larger islands.

* †*Erechtites hieracifolia* (L.) Raf. A single locality on Hog Island.

Erigeron repens A. Gray. Damp, sandy soil, Breton Island; not before reported from east of Texas.

**Gnaphalium purpureum* L. Common on Cat and Breton Islands; a single plant observed at Port Eads.

Helenium tenuifolium Nutt. Abundant at Port Eads, but not observed elsewhere.

Heterotheca subaxillaris (Lam.) Britton & Rusby. Occasional on Cat Island.

* †*Iva frutescens* L. The most common shrub on all low, sandy islands.

I. imbricata Walt. Common on Breton Island; occasional on Sam Holmes, Hog and other sandy islands to the southward.

* †*Leptilon Canadense* (L.) Britton. Common on sand or shell beaches.

L. linifolium (Willd.). Occasional on Cat Island.

* †*Pluchea camphorata* (L.) DC. A few plants on Bird Island and at South Pass.

**P. foetida* (L.) B.S.P. Common on Cat Island.

* †*Solidago sempervirens* L. Not collected in flower, but presumed to be this plant. Breton Island.

Sonchus oleraceus L. Common on shell beaches, Sam Holmes, Sundown and other islands.

Trilisa odoratissima (Walt.) Cass. Abundant on Cat Island.

* †*Willughbaea scandens* (L.) Kuntze. Common on mud lumps, occasional on Cat and Breton Islands.

* ?*Xanthium strumarium* L. A single plant, on Breton Island.

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Explanations of Plates

PLATE 8. *Panicum amarum* dunes, with *Ipomoea acetosaefolia* on the extreme left foreground and *I. pes-caprae* on the extreme right.

PLATE 9. *Iva imbricata* dunes on the sand spit plain; a stem of *Ipomoea Pes-caprae* in the foreground.

PLATE 10. Sand spit plain. *Serenoa serrulata* dunes. In the middle foreground a *Panicum repens* dune. Left foreground *Cyperus cylindricus*. *Pinus Taeda* in the background; pine graveyard on the right.

PLATE 11. Shell dune showing lee margin encroaching on a pure *Batis* association. On the dune *Iva frutescens*.

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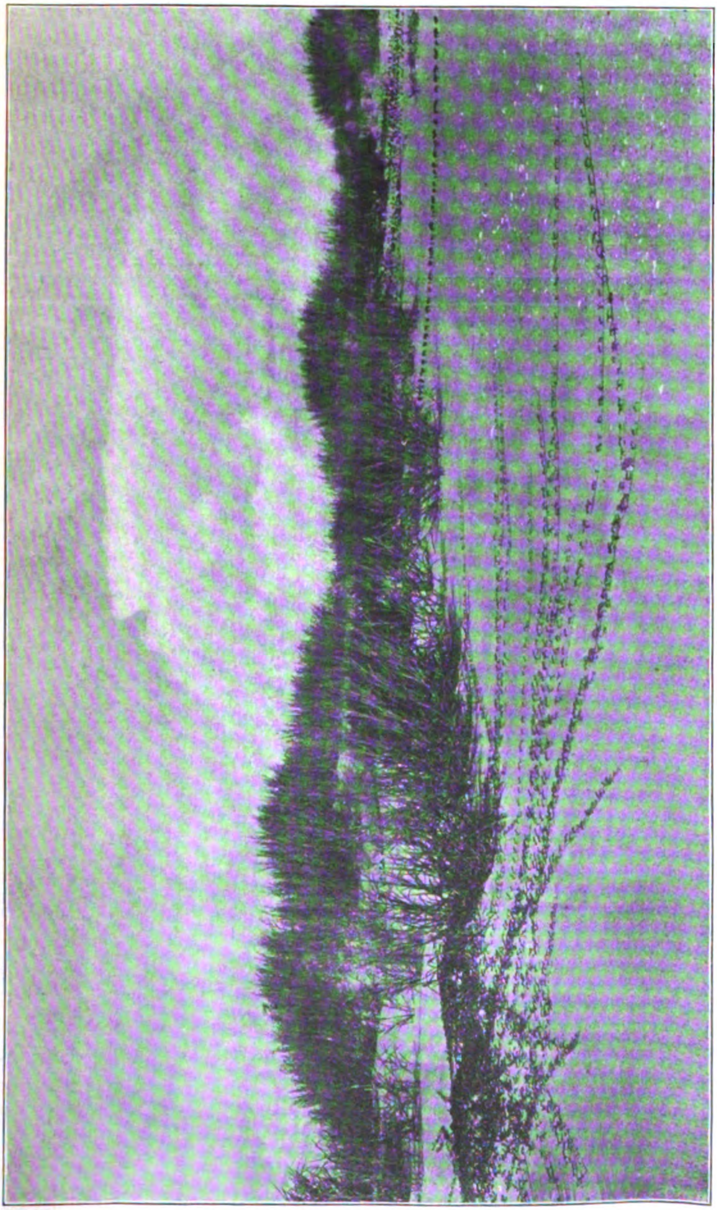
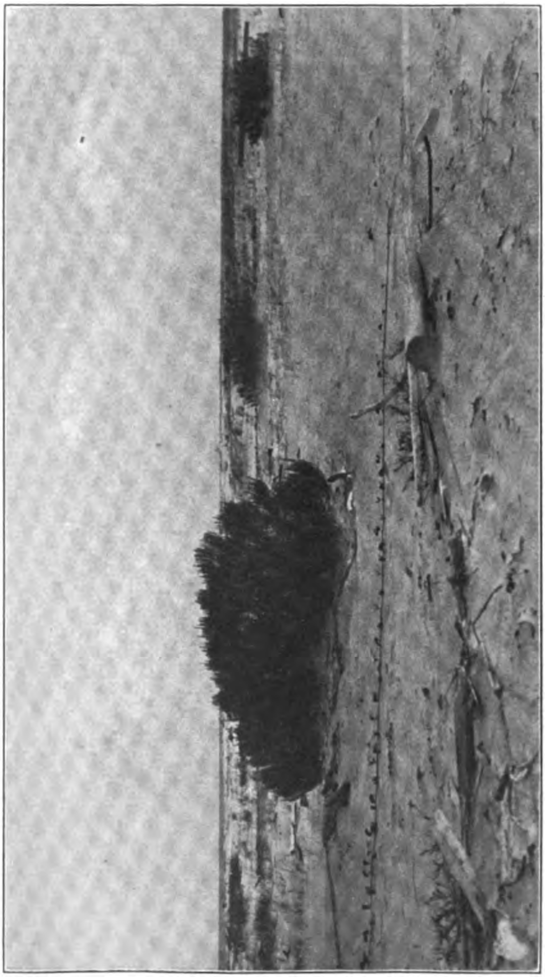
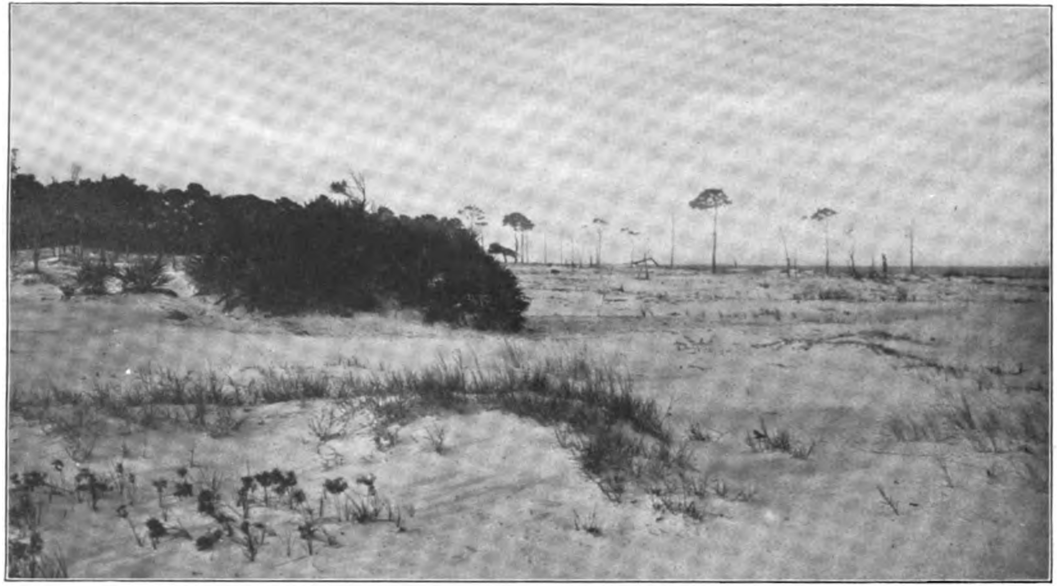


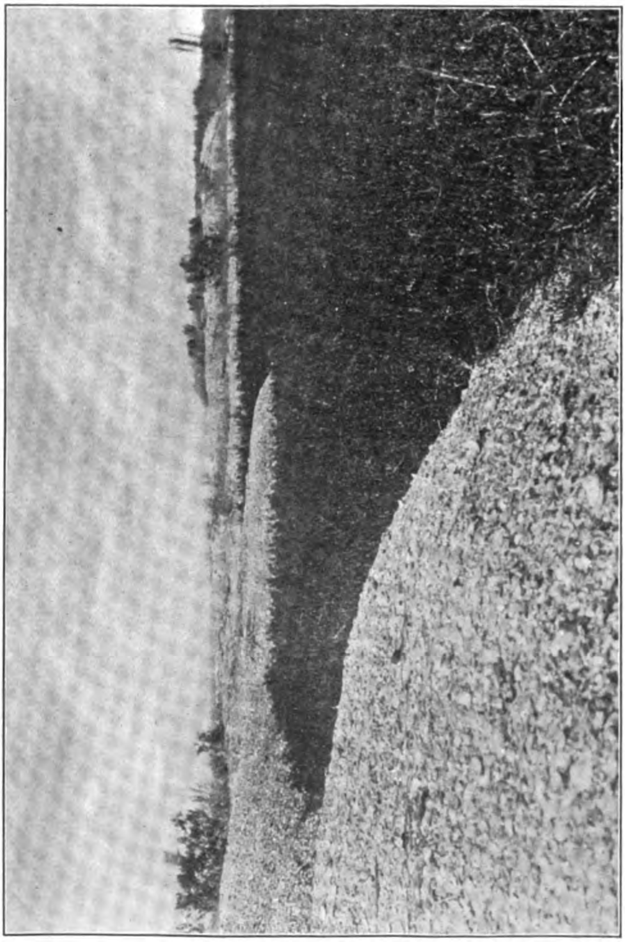
Panicum amarum dunes, with *Ipomoea acetosaefolia* on the extreme left foreground and *I. Pes-caprae* on the extreme right.



Iva imbricata dunes on the sand spit plain; a stem of *Ipomoea Pes-caprae* in the foreground.



Sand spit plain. *Serenoa serrulata* dunes. In the middle foreground a *Panicum repens* dune. Left foreground *Cyperus cylindricus*. *Pinus Taeda* in the background ; pine graveyard on the right.



Shell dune showing lee margin encroaching on a pure *Batis* association. On the dune *Iva frutescens.*

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COLUMBIA UNIVERSITY—No. 175.

THE NOMENCLATURE OF THE NEW ENGLAND AGRIMONIES.

BY EUGENE P. BICKNELL.

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The Nomenclature of the New England Agrimonies

BY EUGENE P. BICKNELL

Under this title in Rhodora for December last, Dr. B. L. Robinson discusses the names of our New England agrimonies, somehow making his way to the conclusion that four of our five species should bear names other than those in current use. My own responsibility for these names is such that this paper might well be personal in some slight way. Its paragraphs, however, quite surpass the reasonable in their personal tone and, indeed, bristle with a sort of porcupine sharpness whereof I am intended to be the victim. It is, nevertheless, gratifying to find my treatment of the species themselves frankly endorsed by so accomplished a systematist as Dr. Robinson, and this, perhaps, is intended to weigh in ample balance against the tone of disagreement and criticism which pervades the remainder of his paper. All the more is this tone and criticism curious since a reconsideration of the whole matter shows that the conclusions so supported really stand for a "retrogressive search after priority," as is inadvertently admitted, instead of such a progressive search as can alone ever warrant any nomenclatural changes.

It may therefore be well to take up the species *seriatim*, following Dr. Robinson, and openly meeting the questions involved in the interest alike of logical principles and sound botany.

AGRIMONIA HIRSUTA (Muhl.)

Dr. Robinson's most serious objection to this name, as may fairly be inferred from his context, is on the score of its having been first used as a varietal designation. In other words, that its author's understanding of the plant which he named proves not to coincide exactly with our understanding of to-day—that some mysterious taxonomic value attaching to it was not fully apprehended by its discoverer when, recognizing its distinctness, he conferred on the plant its distinctive name.

Ostensibly the objection to the name rests on an alleged improper description. Now the question what is a proper and what an improper plant description must ever be something indeterminable by exact rule—a mere academic problem obviously ever open to the danger of receiving a solution far from the domain of practical ideas. As a matter of fact, a majority of accepted descriptions will not survive a certain kind of impossible test. Suffice it, therefore, that the *characterization* of a species, if not wholly by itself, then taken in connection with its context or other evidence, shall fix beyond peradventure the identity of the plant intended.

That this name *hirsuta* of Muhlenberg is unmistakable in its application admits of not the slightest doubt. In advancing a contrary view Dr. Robinson employs a kind of argument pitched somewhere between sarcasm and ridicule, which only betrays the weakness of his position, even apart from an unfairness of statement evidently more a matter of haste than of intent.

No one having given any close heed to our agrimonies can doubt the exact application of Muhlenberg's name. The agrimonies recognized by Muhlenberg were four in number. One other of our seven known North American species—a far southern plant (*A. incisa* Gray) was wholly unknown to him; so that the determination of what he meant by his *hirsuta* lies among three species only instead of among seven, as Dr. Robinson declares. The well-considered selection and often entire sufficiency for purposes of identification of Muhlenberg's descriptive adjectives is well evidenced in his "Catalogue," and it is not at all surprisprising to find that his characterization of "rough-haired" for one of his plants is entirely distinctive. The two eastern species not recognized by Muhlenberg are upon a moment's consideration promptly excluded from being in any way involved; one of them (*A. mollis* Britton) is soft-haired throughout; the other (*A. Brittoniana*) more or less so; while the fact that the latter is partly rough-haired has no bearing, since it is the most northern in range of all our species, not extending south to Carolina, which is expressly named by Muhlenberg, and properly so, as the southern limit of his *hirsuta*. The exact sufficiency and beautiful adequacy of Muhlenberg's characterization of rough-haired is thus apparent. Dr. Robinson's objection that the plant in question is one of the least "hairy" of the group is not at all to the point. Note that Muhlenberg says *rough-haired*, not *rough-hairy*, an acute and very true distinction. If Dr. Robinson objects to the plant being considered hairy it is nevertheless always obviously and characteristically rough-haired.

Nor is this all. In connection with his *Agrimonia Eupatoria hirsuta* Muhlenberg characterizes a variety *glabra*. This is clearly no other than the plant which, following Dr. Gray, I have taken up as the *A. striata* of Michaux. The fact that this plant was by Muhlenberg considered a variety of his *hirsuta* points with perfect directness to just what his *hirsuta* was. This *A. striata* in its leafy parts approaches so close to *A. hirsuta* that its varietal relationship might well be predicated until disproved by critical study. In first attempting the segregation of the two plants it needed the closest and most persistent observation in order to satisfy myself that they were actually distinct.

It may be added that if by his *hirsuta* Muhlenberg did not mean the plant here discussed then he had no knowledge of our commonest, most conspicuous and most wide-ranging species, doubtless also the species commonest and most conspicuous in the region where his observations were more especially carried on.

The "well-nigh necromantic power" which Dr. Robinson invokes to explain my interpretation of Muhlenberg's meaning may thus be identified after all with the most ordinary kind of common sense. It follows that the name *hirsuta* for our common species is scientifically because logically secure.

As for Wallroth's name *A. gryposepala*, which Dr. Robinson would adopt for the species, I am charged with the motive of "displacing" it. As a matter of fact the name had never appeared in American botany until resurrected by me and assigned a place —a clearly rightful place—as a synonym.

AGRIMONIA BRITTONIANA Bicknell

Dr. Robinson's indictment of this name rests upon two counts: first, that the plant is the same as *A. pilosa* Ledeb. of central Europe; second, that both plants are to be referred to the *A. striata* of Michaux.

If the European and American plants are really the same it is a matter of great interest, but I think it can scarcely be held that sufficient study has yet been given to the question to warrant any final pronouncement on this point. It must be kept in mind that we are here dealing with a group of very critical species, and that those of our own country, absolutely distinct as they are, were, within a few years, although common and well-represented in herbaria, hopelessly confused and mostly thrown together under one name. Although I have given much attention to our species, I should hesitate to announce any capital conclusions as to identities founded on anything less than a most careful comparative study of complete material. The specimens of *A. pilosa* Ledeb. that I have myself examined, though few in number, were all from European herbaria and presumably authentic. These examples, apparently, indeed, representing more than a single species, were of plants certainly closely allied to *A. Brittoniana*, but which I could not regard as identical. Nor can the figure of *A. pilosa* Ledeb. in Reichb. Icon. 3 : *pl. 252*, which is cited by Wallroth, be correlated with our American plant.

A most interesting tendency of the more critical study of our plants has been to effect a gradual elimination of European forms once admitted to our flora, and it is certainly still in need of demonstration that a common American agrimony, not of alpine distribution, ranging from Quebec and New England somewhat southward along the Alleghanies and west to the Rocky Mountains, thence south into Arizona and New Mexico, is identical with a central European species.

The brief allusion to *A. pilosa* in my paper has been quite misunderstood by Dr. Robinson. Nothing was attempted in the way of "disposal" of the species, only a mere reference to the confusion regarding it in the treatments of different European botanists. Wallroth placed it as a variety under *A. Dahurica*, an earlier name.

As to the application of the name *A. striata* Michx., here is a case where doctors disagree. Dr. Gray many years ago having seen material of Michaux, as is expressly attested by him, referred it unhesitatingly to the *A. parviflora* DC., also by him examined, this latter being precisely the plant described by me under Michaux's name. Now, Dr. Robinson, having examined a specimen of Michaux in the Jardin des Plantes, declares it to be the same as my *A. Brittoniana*. It is hard to solve this puzzle unless there be in existence, or was in Dr. Gray's time, more than one specimen of Michaux's *A. striata* which thus would represent a composite species. That it was at least a mixed species can scarcely be doubted, since otherwise it would appear that our commonest species was to Michaux quite unknown.

It has been shown that Dr. Gray long ago established the identity of *A. striata* Michx. with *A. parviflora* DC. It remains to be proved that in so doing he was under no misconception in regard to the exact application of De Candolle's name. This is easily done. Both names were placed by Dr. Gray as equivalent synonyms under his own *A. Eupatoria* var. *δ*. An excellent specimen of this variety, so labeled in Dr. Gray's handwriting, is preserved in the Columbia Herbarium. It is precisely the plant which I have taken up under Michaux's name!

Dr. Gray's note on the specimen of Michaux in the herbarium of the Jardin des Plantes "est *A. Eupatoria* var. *minor*" would seem to exclude *A. Brittoniana* from Michaux's species, inasmuch as the latter becomes the largest plant of the group. The difficulties that have been encountered in the past in causing Dr. Robinson to see that critical species in other genera are really different may well be looked on as adequate reason for hesitating to accept his identification of *Brittoniana* with *striata*, in view of the earlier conclusion of Dr. Gray. At this point arises the question whether there is not, or was not in Dr. Gray's time other material representing Michaux's *A. striata*, perhaps in the Richard herbarium.

Michaux's brief description referred to by Dr. Robinson as "rather characteristic" is in reality no more characteristic of one of our species than of several others, and his assertion that his plant had white petals is characteristic of no species. No adequate reason yet appears why the name *A. Brittoniana* should not continue to stand.

AGRIMONIA STRIATA Michx. *fide* A. Gray

Agrimonia glabra (Muhl.).

Michaux's name *A. striata* has now been used in such varying senses that it becomes necessary to use another name in connection with it in order to indicate clearly the plant intended. In my use of the name, as explained in my paper reviving the species and now again in the above discussion of *A. Brittoniana*, I followed Dr. Gray who was at pains to certify to its rightful application. Next in order of priority comes Muhlenberg's name *A. Eupatoria glabra* which, as we have now learned, should be rendered *Agrimonia glabra*, a most fitting designation, being wholly inappropriate to any other one of our species.

Dr. Robinson's assumption that, had I taken due note of the type-station of Michaux's plant, I could scarcely have failed to surmise its identity with my *A. Brittoniana* is quite wide of the mark. As well might I have predicated the identity of Michaux's plant with *A. hirsuta* Muhl., also an inhabitant of the same region. Any surmise of the kind would, in fact, have been presumptuous in the face of Dr. Gray's explicit announcement of the exact identity of Michaux's plant. Moreover the ranges given in my paper were expressly stated to be incomplete —"based alone on specimens actually examined and doubtless subject to considerable extension in some cases." As a matter of fact the species *A. glabra* (Muhl.) does occur in the Dominion as attested by specimens since examined from lower Canada.

The name *A. microcarpa* Wallr., which Dr. Robinson would adopt for this species, was unfortunately not given with an interrogation in my synonymy as it should have been. A better insight into the matter has since shown that the name has no application to the plant in question, but almost certainly refers to some form of the species taken up by me as *A. pumila* Muhl. Wallroth's name *A. rostellata* is, however, clearly applied to the plant, but is antedated twenty-nine years by Muhlenberg's *A. glabra.*

AGRIMONIA MOLLIS (T. & G.) Britton

That the name *A. platycarpa* Wallr. "will be preferred by conservative botanists" for this species is open to grave doubt. The conservative botanist who proceeds by preference rather than by rule is lost from the start. The first distinctive appellation for the species was *mollis*—*mollis*, therefore, instantly became its inalienable name, personal preference now to the contrary notwithstanding.

But even were it necessary to adopt a name of Wallroth's for the plant Dr. Robinson's choice of *A. platycarpa* would still be erroneous. I am here myself at fault through having omitted the mark of interrogation in taking up this name in the synonymy of *A. mollis*. It is not at all clear that the name does not refer to one of the apparently several forms or species included under *A. pumila* Muhl. At any rate, the name quite certainly does not pertain to the type of *A. mollis*.

I am well satisfied that *A. mollis* is an aggregate actually embracing a group of species. But in order to elucidate this a greater amount of material than is now available and the closest study will be indispensable. It may then be possible to give to Wallroth's name a definite meaning. There seems, however, little reason to doubt that Wallroth's name, *A. pubescens* is rightfully assigned to the synonymy of *A. mollis*.

All things considered it can only be regretted that a wholly unnecessary confession has been introduced into the nomenclature of our agrimonies. Changes in botanical names, necessary evils at best, are especially to be deplored when proposed in disregard alike of easily ascertained certainties on the one hand and of palpable uncertainties on the other.

In what has been written in support of such changes in the names of the New England agrimonies nothing is brought forward which at all justifies the displacement of any of the names previously adopted.

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